

SOME OUTLINES FOR THE SOCIOLOGICAL STUDY OF TECHNOLOGY

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ABSTRACT:

Within sociology, technology is not a common subject for sociological analysis; technology is often treated as if it were no more than an asocial physical product. The argument of this thesis is that technology is as available for sociological analysis as any other social phenomenon. In popular representation, technology is treated as if it were special, and this treatment has had particular consequences for sociological analysis. This thesis attempts to put this special, deferential, attitude to technology aside, and to reveal technology as an unexceptional topic for sociological investigation.

Stated baldly, two ideas are demonstrated in this thesis. The first of these is: The way that technology is constructed as a category in sociological literature makes the topic technology resistant to sociological analysis. The second idea follows from this: It is possible to develop a sociological account of technology by reference to a reconceptualised notion of work.

The thesis considers those sociological approaches which appear to offer some potential for an elaborated sociology of technology. These move from conventionally academic discussions of a sociology of technology through marxian, culturalist and feminist accounts of work and of technology, to a consideration of the views of technology embodied in particular instances of policy and local action.

A view of technology emerges which draws on the divergent traditions of marxian political economy and marxian cultural studies. The thesis concludes with an attempt to embrace both these perspectives in the development of a sociology of technology.

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PART ONE

CHAPTER I : INTRODUCTION: TECHNOLOGY AS A SOCIAL PHENOMENON

Conventionally sociological theses critically review relevant literature; or refine some aspect of theory; or attempt to apply general theory to particular circumstance. Some theses ambitiously attempt all three approaches. This is not a conventional sociological thesis, its subject matter is technology.

At first sight it seems curious to suggest that the form of argument is structured by the subject matter. All manner of social phenomena have been shown to be available for sociological analysis, and there seems, on the face of it, nothing particularly distinguishing about technology as an object of knowledge. Indeed, evidence from other branches of sociology suggests that the most unlikely subjects are available for analysis; within the sociology of science, for example, contextual studies have shown how even such phenomena as chemical and physical events may be seen to be structured by social dynamics (Shapin 1982). However, the sociological study of technology appears to pose particular problems: suggested firstly by the relatively low levels of sociological activity in this area; secondly by the apparent analytical neglect, even when technology is addressed in sociological texts, it is treated in a relatively uncritical way. Where sociological investigations of scientific practice have focused upon such social processes as laboratory life, the construction of theoretical models, and the economics of research, technology has yet to be sociologically recognised in this way.

"Technology" as a sociological category appears to be largely assumed rather than argued; largely taken for granted as an asocial physical phenomenon; within sociology "technology" is widely taken to have an identity or close association with the hardware of paid production.

The argument here is that technology is available for sociological analysis, but that currently within sociology technology is treated in a particularly asocial way which inhibits the elaboration of such an analysis. The aim of this thesis is to indicate the limitations of current sociological approaches to technology and to point to elements which can form the basis of a more adequate sociology of technology.

In part, sociological accounts of technology appear to be constrained by their use of prevailing and commonplace definitions of technology. In popular representation, technology seems to be constituted as special and separate from the concerns of everyday life. Technological workplaces are presented as domains of specialist knowledge, technique and equipment. Technology is accorded a distinctive and specialised status. This thesis will argue that this distinctive character of technology in popular representation is reproduced intact within sociological texts. It will be argued that the special and exclusive associations of technology are not only reproduced but also pass unrecognised as phenomena for sociological investigation.

The discussion pays particular attention to the phenomenon of "new technology", to the development and

application of electronics and computing, a phenomenon which has attracted some sociological attention. In both popular representation and in sociology, "new technology" has been particularly associated with efficiency, reliability and modernity. This association itself is of particular interest here, not because new technology is so special, so radically different from anything that has gone before that it deserves distinctively different sociological treatment, but because the association is an indication of the way in which social commentary has taken over popular representation. The focus here is on sociological approaches to technology, not on supposed revolutionary breaks in technology, and here, the argument will go, the conventional sociological treatment of "new technology" has too readily incorporated journalistic notions, has been constrained by a deference to things technical, and has been uncharacteristically uncritical.

One central aim of the thesis then is to step back from popular and sociological concepts of "new technology" and to offer a theoretical account which relates to both sets of representations. I will try to show that technology, even the glossy new technology, has more in common with other social phenomena than is conventionally recognised.

There are many reasons why technology might invite sociological study, some of the particular emphasis of this thesis are here introduced:

TECHNOLOGY IN SOCIOLOGICAL LITERATURE

A first source of interest is that way in which technology has been constituted as a topic of sociological concern. In large part, sociological commentary on technology has taken a particularly circumscribed form, it has been closely associated with industrial sociology, and thus to the labour/management concerns of the workplace. It may be argued that in both its liberal and marxist traditions, industrial sociology has characterised technology in a determinist way, as an independent variable acting upon the social organisation of the workplace. A further consequence of the industrial sociology perspective is that technology is seen to be synonymous with the technology of paid production, especially in manufacture and in the private sector.

This thesis will try to show that, as a social institution, as a set of working practices, and as a cluster of representations, technology has been barely recognised in sociology. Any attempt simply to survey the literature formally addressing the "sociology of technology" would yield a fairly small collection of texts, and a discussion of a few significant issues: the form, content, and consequences of technological change; the relation between technology and the knowledge producing activities of science; case studies which rest on linear models of innovation; and attempts to deploy existing sociological approaches - social construction and labour process theory - to explain the social shaping of technology.

That technology is treated in a relatively ahistorical, acultural way, is particularly evident in recent

sociological literature on the new information technologies. As Robins and Webster (1986) have indicated, the sociological literature on the new technologies falls into three broad categories: attempts to predict the consequence of technological change, "futurology"; debates about the 'post-industrial society'; and analyses of the impacts of the scientific and technological revolution. Each approach rests upon a presumption of the relative autonomy of technological developments. McKenzie and Wajcman (1985) argue that a sociological appraisal which focuses upon the impacts and consequences of technological change inescapably implies a determinist stance toward technology. It will be argued here that existing approaches to the sociology of technology are characterised by a determinism which denies or at best minimises both the cultural context and the human purposes which frame technological products and processes.

Marxian writers have presented technology as a central motor to the increased productivity which, it is argued, will make possible the transformation of the relations of production. This conception of the liberatory potential has a long history in Marxist and socialist thought: from Lenin's enthusiasm for Taylorism and electrification; through Bernal's advocacy of the use, rather than abuse, of scientific findings; to the more recent enthusiasms of lesser figures - Harold Wilson ("white heat of technology"), Ken Livingstone ("technology is the key"), and the contributors to the Marxism Today debate on the progressive potential of new manufacturing technology, popularly dubbed New Times. Despite this theoretical

importance in the grand scheme of things, technology itself - even if confined to the products and practices of technical work - does not appear to have been given detailed treatment within marxian sociological analysis.

TECHNOLOGY AS ARTEFACT

A second source of sociological interest in technology derives from the association of technology with physicality, with hardware. Technology, like other artefacts, takes shape within historically specific conditions. By emphasising firstly hardware, and secondly the consequences of technological change, sociology does not, in general, examine the social relations of technological production, does not set the generation of particular forms of hardware in a social or historical context, does not acknowledge the human labour which constituted the hardware, nor the social organisation within which that labour was harnessed.

Other kinds of social and human products - a painting, a book, a town plan - do not appear to present such obvious difficulties for sociological analysis. Whilst writers may assert the social origins of technology, their analysis does little to recognise the full import of that assertion; technology is treated as special. The apparent immutability of physical products resists sociological exploration, this is particularly the case where technological artefacts are concerned. Technology represents problems for sociology both as a physical product and by its association with technical knowledge and processes. And technology frequently gains a further layer of

objectification from its status as a commodity in the market.

From a sociological perspective, technology cannot be understood as neutral hardware; like any other product of human labour, technology has a context, is built for particular purposes, and has associated social practices. Thus it should be possible to view technology as a cultural product with sets of associated practices, meanings, and imagery.

By uncritically linking technology to production sociology has reproduced the strong, taken for granted, association between technology and machines, between technology and hardware, an association which works to remove technology from sociological analysis. The view taken in this essay is that technology cannot be reduced solely to hardware, that technology is more than inert physical matter, that technology also embodies the meaning, values and imagery which give matter cultural life. If technology is identified solely with hardware then the many social practices which define 'technology' as a cultural phenomenon are excluded from analysis. A focus on hardware masks, for example, the ways in which some artefacts come to be defined as technology at all, the ways in which some hardware becomes associated with the resonances and legitimations of 'technology', whilst some artefacts do not.

There are, however, dangers to this approach. An emphasis on the cultural production of technology may too easily obscure or dismiss the physicality of technological products. And whilst it may be argued

that physical products are sociologically meaningless divorced from their cultural context, it is equally unsatisfactory to idealise technology away into sets of 'representations' (although much depends on the extent to which representation is taken to be a material practice). Some resolution of this difficulty may be possible when technological artefacts are seen as the product of human labour, products which have their own relations and circumstances of production, products with a history.

From a focus on human labour, technological products may be seen not in terms of technical wizardry, but as a product of human ingenuity and effort. And human work may be variable, unpredictable, irregular, whilst also being creative and difficult to quantify, replicate, or control. An ahistorical, asocial conception of impressive hardware draws attention away from this constitutive labour and thus away from the variabilities and vulnerabilities of technology as an historical product of human labour.

TECHNOLOGY AS SOCIAL ENIGMA

A further reason for making a sociological exploration of technology is its apparent contradictoriness. Within popular representation, everyday life, and sociology, the concept of technology is surrounded by ambiguity: to both producers and consumers technology may seem to be, at times, gloriously work enhancing, time and labour saving, and a key to wealth generation. At other times, technology also appears in a less benign light, as an irresistible jobkiller. Technology may appear to be both liberatory and oppressive, and

yet, for consumers, further ambiguity is added by an everyday reliance on technological products, everyday reminders of technological dependency. Such dependency is associated with technological products which, after being developed, become integral to patterns of work and of daily life. The progressive dependency associated with such products can become strikingly evident when they break down. A cut in the electricity supply, for example, is an awesome reminder of a heavy reliance on this technology for the detail of daily life.

The liberatory, oppressive, or dependency aspects of technological products may seem to derive from the ingenuity and efficiency of the products themselves; some products appear to be the very embodiment of usefulness. Yet the technological product which, for one is indispensable is, to another, an unnecessary gadget. Both the desirable and undesirable characteristics of technological products derive, it seems, not so much from their inner construction as from their use in particular contexts, from the relation between particular products and the productive relations within which their usefulness or value can be realised.

One consequence of the industrial emphasis of sociological views of technology is the emphasis given to productive work, to technology in production, to the design and manufacturing process; an emphasis which may be termed productivist. I shall argue that relations of consumption and between production and consumption have an analytical importance which equals that of production. Technological products may be

seen to derive from, to embody, human work in past production. But products also shape, facilitate, or even lighten human labour in their consumption. Thus technological products may be seen to mediate or integrate labour processes in the past with those of the present. This thesis takes the view that the production and consumption of utility has been a neglected aspect of sociological theorising about technology and technology-related work.

The utility of technological products has, for some commentators, been seen as a central criterion for design (Cooley 1987). Yet, like hardware, the concept of utility may be said to be meaningless outside particular contexts of use. Later discussion will consider the social constitution of useful technological products - as one means of addressing the ambiguity of liberation, power and dependency to be found in popular conceptions of technology.

TECHNOLOGY AND SOCIAL DIVISIONS

An additional reason for taking technology as a sociological topic relates to conventionally defined technological workplaces. The strongly framed divisions of labour which surround technological work mark out technology as associated with relations of expertise and of masculinity (Cockburn 1985, McNeil 1987, Hacker 1989). By a focus on the technology of production, sociologists have adopted taken for granted definitions of technology, definitions which refer largely to the technical artefacts of industrial and commercial production, definitions which, in practice if not design, stress men's rather than women's work.

The gendering of technology has, in consequence, received relatively little acknowledgement within industrial sociology. In general, case study material of factories focuses chiefly on men's work with no analysis of the significance of this focus. There is a small body of empirical literature relating the effects of new technology on clerical work to women's marginality in the labour market (West, 1982). There are, however, few attempts to explore the gendered constitution of the technological practices themselves - of the processes and expertise associated with new technologies.

Feminist writers have approached technology in differing ways: they have discussed the consequences of technological change on women's employment (West, 1982); considered the technologically related changes in domestic labour (Schwartz Cohen, 1983); and brought a gender dimension to discussions of technological futures (Zimmerman, WSIQ 1981). Whilst such work is useful, it stresses the consequences of technology rather than explore the gendered character of the development and production of technological artefacts, or the social processes which constitute technology as a gendered cultural product.

Relations of expertise also present difficulties for a sociology of technology. Technology is commonly associated with specialised knowledge and technique; for most people, technology is not ordinary. Technology appears to be a special and specialised field, technology has associations of power. In complex ways technology seems to be associated with the power of those social groups who own, deploy, control, or

maintain it. Because of this association, a concern about technology is inescapably a sociological concern, a concern about the distribution and maintenance of power in society. As to the particular ways in which technology and power interrelate - whether technology may be seen as a representation, embodiment, instrument, or mediation of power, and how may sociological insights be used to analyse aspects of technological power - these concerns form the core of this thesis.

TECHNOLOGY AS A CULTURAL PRODUCT

The focus of industrial sociology on hardware, and on paid production, has contributed to a powerful taken for granted view of technology in sociology. The view taken here is that there is a distinction to be made between an analysis of the production of artefacts, and an analysis of the processes of attributing the label 'technology' to particular artefacts. Thus the question of how artefacts and practices become 'technology' is not reducible to philosophical questions of "what is technology?" A sociological concern may be addressed rather to "what are the practices which define technology?" and "what sources of power ascribe 'technology' to particular social phenomena?" Again, comparisons with the sociology of science highlight the point. In Science in Context, Readings in the Sociology of Science (1982), Barnes and Edge explicitly exclude any exploration of the processes which define activities as 'scientific' and 'technological'.

...our concern is with science purely and simply as a phenomenon; that is, with activities generally accepted and described as scientific, with knowledge and culture generally described, with contexts generally so described. Our concern with technology is of just the same kind. Sociological studies must attempt to take science and technology as they find them, and not themselves stipulate what scientific and technological activities ought to consist in. (Barnes and Edge, p.147)

Barnes and Edge put their faith in technology as it is found. But where do they draw the line? And if they opt simply to explore highly conventional areas of technological activity, then how can they be sure of the general value of their analytical insights? How can they be sure that conventional definitions of technology do not themselves embrace important social elements?

It may be argued that, in an effort to avoid idealist definitions of science and technology, Barnes and Edge have opted too quickly for an empirical stance. They offer a choice between technology as it is found and what technology 'ought to consist in'. But it may be argued that the choice should also include the social processes which contribute to the definition of technology as it is found, to the cultural constitution of what passes for technology and the meanings associated with technology.

One of the tasks, then, of a sociology of technology may be seen to be the exploration of the social

processes which attribute 'technology' to one artefact, and not to another. Such processes are curious - some machines, some kinds of work, some groups of workers, some techniques, carry a close association with technology. Yet 'technology' is also constituted by language, imagery, and forms of media representation. The close association of technology with the hardware of paid production works not only to exclude non-commercial sites arguably concerned with the production and use of technology, but further, this exclusion extends to those whose work - in ideology and in representation - also contributes to taken for granted notions of technology. The social processes which together define what passes for technology have not been the subject of close sociological analysis. Technology is a complex cluster of artefacts, practices, and associated meanings. Technology in sociology has been a relatively undifferentiated, and largely rhetorical, category. However, for the purposes of discussion in this thesis, there is an important distinction to make - the distinction between technology which is the object of knowledge of industrial sociology and "technology" which is the object of knowledge of a more culturalist approach to human work. Technology is here used to denote the products and process of paid workplaces, as seen from the perspective of industrial sociology. "Technology" here denotes the cultural products of representation, the meanings and imagery and resonances of the technological which may stem from both paid and unpaid work.

Away from the formal study of technology, a number of social theorists - historians, feminists, ecologists,

and cultural studies writers, among others - have sought to explore beyond economic factors to explain the constitution of modern society. They have attempted to move away from a narrow concept of class relations and to indicate the many sites, in addition to the paid workplace, where powerful social divisions are enacted, elaborated, and reproduced. Whilst not explicitly concerned with technology, such a wide ranging exploration of cultural activity may make some contribution to the sociology of technology.

THE PHENOMENON OF NEW TECHNOLOGY

The association of "new technology" and modernity, outlined earlier, provides a further reason for taking technology as a topic of sociological concern. The recent phenomenon of "new technology" may be seen as an illuminating case study.

The period 1976-82 saw the rise of "new technology" as a media event, as a governmental concern, and as a sociological topic. The ready association of "new technology" with a reduction in employment levels and the popularity of Braverman's deskilling thesis combined to make "new technology" a fearful social force. The similarities between journalistic commentary, popular representation, and sociological discussion provided an unusually clear example of the ways in which technological change appears to be constituted, across a number of social practices, as separate and socially autonomous. Commentary on "new technology" has been largely characterised by an uncritical optimism in the capacity of technology to

substitute for human work. Belief in the efficacy of new technology characterises both optimists, who see wealth or leisure generating possibilities in the new electronic forces of production, and those pessimists who see deskilling and unemployment as the fruits of new technology. And beyond the workplace, ecological critiques of modern society similarly assume the efficacy of new technology in their comments of the progressive removal of all areas of personal decision making. This lack of criticism, which is particularly stark in debates about "new technology", may itself be seen as a powerful force in the cultural constitution of an apparently asocial technology.

Since the mid 1980s the "new technology" phenomenon has taken another and apparently more benign expression. The focus of debate has moved from deskilling to the notion of transformation associated with the new technologies. The cheapness, speed, and data handling powers of computer technology have been presented in a democratic light, with particular stress on the deployment of computing to assist in the distribution of information. Government sponsored databases, on education and training opportunities for example, typify the way in which attributes of new technology are taken to be socially useful in themselves, without regard to context or to the purposes of users.

A further example of deference to the capacities of new technology is to be found in the recent debates within socialist journals about Post Fordism, or New Times as it was called in a special issue of Marxism Today. In broad terms the argument, draws upon sociological literature about industrial technology, in particular

about the ways in which flexible manufacturing systems provide for the flexible firm, centre/periphery divisions of labour, and continuously variable production. It is argued that the consequent growth in choice for shoppers has shifted the focus of political activity from production to consumption - a mighty claim to rest on the largely unexamined ability of flexible manufacturing systems. Within the space of fifteen years, virtually the same "new technology" has provided a basis for projections of deskilling, of transformation, and of post Fordism - fairly rapid shifts which themselves suggest the lack of a sound sociological grasp on the phenomenon of technology.

It appears that sociological views of technology have been heavily influenced by the relatively narrow concerns of workplace focused sociology. Just as the concept 'work' embraces a wider range of human activities than the industrial concern for employment, so, too, does the concept 'technology' embrace more than the hardware of paid production. Yet, the relations of technical expertise associated with technology, coupled with the technological determinism to be found in sociology, together work to deny the wider cultural constituents of technology.

Technology is associated with things, rather than with human work; with masculine employment, rather than with women's work; and with modernity and efficiency, rather than with the vulnerabilities and uncertainties of human work. Technological change is not seen as a subtle, multi-faceted, cultural and power related process. Taking new technology as a particular instance of a broader phenomenon, this thesis argues that a sociology of technology must necessarily embrace

the ways in which the social category of "technology" is constructed in sociology, that this has been a neglected area of sociological exploration, and that this neglect may in part be overcome by a focus on work, on the human work of producing and using technology.

WORKING WITH TECHNOLOGY

There remains one final, biographic, reason for focusing on technology. My M.A. dissertation Teachers' Work: the Division of Labour was written in 1977-78 at the moment of great sociological interest in labour process analysis and popular concern for the job restructuring effects of new technology. That dissertation considered the adequacy of differing approaches to the analysis of teachers' work: economic, technological, and ideological. This present work represents a development of that interest in technology, an interest which has also been furthered by more practical involvement with technology in several contexts: in adult education; in an Information Technology Centre; and in the setting up of a Technology Network.

This practical engagement, some of which is reported in this thesis, has taken place at the same time as a continuing academic interest. One consequence of this duality has been a considerable tension between the coherence and relative simplicity of sociological literature on technology and the conflicts, discontinuities, social rigidities and pressing immediacies encountered in more practical attempts to develop an understanding of technological work.

A second consequence of working on both an academic and a practical terrain has been more directly productive: the practical work, which in differing ways is related to technological education, has been informed by a continuing sociological debate. This has proved a useful defence against the pervasive tendency in technological workplaces to reduce decisions to matters of technical knowledge. At the same time these practical activities have provided a context within which to review sociological literature concerned with technology. The frustrating limitations of this literature, a discussion which forms a major part of this thesis, derives substantially from this biographic involvement.

The form of argument is also related to a biographic mixture of academic and practical engagement. This thesis attempts to chart the narrow terms within which technology is constituted in sociological literature. It also attempts to indicate ways in which sociological exploration may move outside those narrow sets of concerns. This last aim has proved especially difficult since the discussion can so easily reproduce the limitations of the available literature. In order to step outside sociological limitations, I have drawn upon non-sociological literature and on reports of practical technological work experience. These sources are used to demonstrate the limits and possibilities of a sociology of technology.

Within sociology, and industrial sociology in particular, technology has remained largely on an asocial pedestal of technical exclusivity and expertise. In order to examine the sociological

constituents of technology, it will be necessary to explore some of those social practices which together constitute technology in particular settings. This will be no easy task. The difficulties of unravelling the social divisions of technologically related work from the apparently asocial necessities of technical specialisation and expertise go some way to demonstrate the complexities of a sociology of technology. Here, sociological accessibility is sought by an emphasis on concrete detail, on the different sets of interests and perspectives in workplaces which produce, consume, constitute technology.

The discussion places a priority on the concrete, the specific, the substantive. Conceptual debate is here illustrated with instances of particular technology-related workplaces, with accounts gathered from participants. The intention is not to attribute greater legitimacy to participants' perspectives. The significant amounts of workplace detail which are included are intended to contribute to the argument that technology, like any other cultural product, can only be understood in a particular social context. Participants' descriptions of workplace events invariably embrace a wide variety of interrelated events, forces, histories, and purposes which contribute to the overall integration of work. Participants', workers', accounts are used here to illustrate the significantly non-technical, non-economic dimensions of technological practice.

These, then, form some of the sociologically intriguing aspects of technology. There are, of course, a range

of other reasons for technology to be the subject of sociological analysis. The relevance, for example, of studies in the sociology of science to those of technology provides a rich vein of enquiry; or the extent to which, for another example, the history or philosophy of technology may relate to a sociological study. None of these forms the focus of this thesis. The emphasis here is simply on indicating some of the elements of a sociological account of technology.

AN OUTLINE OF THE ARGUMENT OF THE THESIS

Stated baldly there are two ideas to be demonstrated in this thesis. The first of these is: The way that technology is constructed as a category in sociological literature makes the topic technology resistant to sociological analysis. The second idea follows from this: It is possible to develop a sociological account of technology by reference to a reconceptualised notion of work.

These two ideas are developed from a starting point of curiosity about technology; the sociologically intriguing thing about technology is that it is so often treated as if it were no more than an asocial physical product. The argument here is that technology is as available for sociological analysis as any other social phenomenon. It is argued that, in popular representation, technology has been treated as if it were special, and that this treatment has had particular consequences for sociological analysis. This thesis attempts to put this special, deferential, attitude to technology aside, and to reveal technology

as an unexceptional topic for sociological investigation.

What follows, then, in the subsequent chapters, are differing attempts to review the limitations of existing sociologies and to explore more coherent ways of constituting technology within sociology. Together these attempts form the outlines of a sociology of technology. The chapters differ in style and approach with the stress moving between academic and practical areas of work.

The initial assumption of this thesis is that technology has been given short shrift in sociological analysis. The thrust of the discussion here is to explore that neglect and to ask what form could a sociology of technology take.

The argument of this thesis has four interrelated strands:

1. A first strand concerns the ways in which technology, especially new technology, is constituted in sociology. The thesis will present the view that sociological approaches to the study of technology are inhibited by an uncritical deference to technical products, knowledge and expertise; to be characterised by a pervasive technological determinism; and uncritically to assume the efficacy of new technological products. Despite technical and popular representations to the contrary this thesis will present the view that technology is not self-acting nor necessarily associated with efficiency, nor necessarily superior to human actors, rather that there is a

distinction to be made between human and non-human modes of performance.

2. It appears that technical knowledge and the sharply drawn divisions of technical labour contribute to a marked exclusivity surrounding technological products and processes. An exclusivity which, by its specialist knowledge, resists sociological analysis. A second strand proposes that an exploration of technologically related work, of the human labour of producing and using technological products, provides some sociological means to transcend the awesome certainties associated with technical hardware. The concept of human labour is, however, itself a matter for debate. This is most especially so where technologically related work is concerned. It will be argued that Marx's concept of labour process lends itself to a more embracing analysis of technologically related work than contemporary labour process writers have recognised. By a re-interpretation of Marx's concept of labour process, a concept of technologically related work is elaborated which extends beyond paid production in technical workplaces, beyond paid production in general, to the constitutive activities of a broader range of human work.

3. The project then is to give a sociological account of technological practices. A third strand turns to a culturalist tradition to augment the exploration of those practices. Marx' account of the human labour process, as elaborated here, provides some insight into the ways in which past and present labour combines to produce utility and value. There are, however, ways in which the Marxian account is lacking: Marx' notion of

work stresses the physical, the material, the contextual, but does not address the symbolic and subjective aspects of human work. The Marxian account is focused upon those who produce and consume the artefact or the service, the marxian account stresses the production and consumption of utility. Yet this approach cannot address the broader constitution of technology as a cultural product, does not explore the many other workplaces and practices which constitute 'technology' as a social phenomenon. A cultural studies approach potentially offers two things, a different perspective on human work, and a broadening of the notion of workplace. The discussion then tries to take account of the ways in which a culturalist perspective may be deployed to illuminate the subjective dimensions and social divisions of work. The cultural studies perspective potentially offers a way to explore technology not as a matter of technical hardware but as a product of a wide range of constitutive social processes and practices. Focusing on marxian approaches to cultural studies, the thesis considers the extent to which a culturalist perspective can provide some insight into these practices.

A note of qualification is needed here. Work in cultural studies is emergent and unevenly developed; current literature focuses particularly on representation, social divisions, and social interaction which is outside paid wage relations. Even within marxian cultural studies, few writers have discussed work, and there has been very little debate of technology in either its symbolic or material aspects. The culturalist perspective can, at best,

provide an indication of the direction of future work.

4. The thesis argues that technology may be explored by reference to human work, and also that 'technology' - as a material and symbolic category - may be explored by reference to a wide range of social practices, including paid work. Where a marxian account of labour process may offer illumination of past and present work, a cultural studies approach appears to offer some tools for the analysis of representation, for the constitution of 'technology' as an ideological category. There are a number of obvious ways in which popular accounts of technology may be explored in a culturalist way. One could, for example, look at the ways in which the notion of 'technology' is deployed in television news; in documentary programmes as diverse as Horizon and Tomorrow's World; in newspaper reportage of industrial disputes, economics, and company news; in science fiction and war cinema; in contemporary debate about such issues as reproductive technologies, bio-engineering, electronic tagging and defence systems. These are clear cut arenas for media studies analysis, these are sites of representation. And, logically, such images must contribute to popular understandings (importantly plural) of 'technology' and of its particular forms. But it is not possible to separate media representations of 'technology' from other practices which more materially constitute 'technology'. **The aim here is to move away from a notion of representation as a distinct set of practices and to focus instead on human work in both its material and symbolic aspects.** The thesis takes the view that

all work is both economic and representational; that it is modes of analysis which may be distinguished, not the phenomena or the experience. The argument here is that images, representation, and understanding of technology are produced and circulated in a wide range of paid and unpaid workplaces. A fourth strand recognises the theoretical difficulties of reconciling a productivist with a culturalist perspective and turns to concrete examples to point to the ways in which meaning and interpretation relate to the Marxian categories concerned with the production and consumption of artefacts.

This thesis, then, considers those sociological approaches which appear to offer some potential for an elaborated sociology of technology. These move from conventionally academic discussions of a sociology of technology through marxian, culturalist and feminist accounts of work and of technology, to a consideration of the views of technology embodied in particular instances of policy and local action. As the discussion moves away from an explicit focus on technology and towards the social constituents of the work of producing and using artefacts, then it appears that the category technology becomes less exclusive, less asocial, and whilst more complex, more available to sociological analysis. The thesis concludes with proposals which may contribute towards a more fully socialised account of technology.

The following chapters each take a different aspect of the social constitution of technology. The argument develops as follows:

An Outline of Part Two.

CHAPTER TWO : THE SOCIOLOGY OF TECHNOLOGY

The first of these approaches to a sociology of technology - chapter two - considers the few innovative studies in recent literature on the sociology of technology. The chapter considers those writers who have attempted to consider technology as a normal topic for sociological investigation. It discusses some sustained attempts to explore technology as a social phenomenon, draws attention to their theoretical diversity and the notions of technology which are developed within this literature.

Recent literature within the sociology of technology attempts to extend the contextual and social constructivist approaches developed within the sociology of science to embrace the social shaping of technology, in particular to explore the development and deployment of artefacts. Pinch and Bijker (1985), for example, explicitly promote the non-special character of technology.

...our intention of building a sociology of technology which treats technological knowledge in the same symmetrical, impartial manner that scientific facts are treated within the sociology of scientific knowledge.
(p.406)

Seeking to establish the ordinariness of technology they look to the sociology of scientific facts. By such means they risk inheriting significant difficulties from the sociology of science: firstly

the comparison with the sociology of science may result in reproducing the weaknesses of that literature, in particular the relative neglect of power relations, most especially relations of expertise; and secondly the unexamined assumption that technology is merely the application of science. Pinch and Bijker courageously strive to treat technology as any other social phenomenon. However, they give no analytical recognition to the great difficulties associated with establishing the sociological ordinariness of a phenomenon which, in everyday life, is treated as specialised. There is an important distinction to be made here between the way technology is treated in everyday life and the way technology may be explored in sociology. Within popular representation science and technology are regarded as special and epistemologically privileged. That representation provides an interesting arena for sociological study and has to be given acknowledgement and analysis. The analysis itself does not have to be sociologically special or distinctive. The emergent study of the sociology of technology has yet to consider this ideological dimension of technology.

The discussion points to the relative strengths and limitations of this literature, and the contribution it can make to a more elaborated sociology of technology. The strengths lie in the sociological rigour of these recent attempts to elaborate analyses of technology: ideologically and conceptually technology provides a hard test-case for sociology. Writers have resisted the tendency to see technology as a specialised phenomenon and have sought to explain apparently technical events in sociological terms. The

limitations are that such accounts take technology as a conceptual given, writers do not explore those social processes which define what passes for technology, nor the constitutive relations of gender and expertise which form part of those processes.

In these texts technology is treated largely as an asocial phenomenon - even by those whose project is to develop a socialised account of technology. Recent attempts to develop a sociology of technology are shown to be flawed, the thesis looks elsewhere to another sociological tradition, to marxist labour process analysis, to examine its potential contribution to a sociology of technology.

CHAPTER THREE : TECHNOLOGY AND THE LABOUR PROCESS

Chapter three turns to a marxian account of labour process to explore the ways in which technology may be understood by reference to human work. Until 1974 the sociological exploration of technology had been largely the province of industrial sociology, where the emphasis had been on the relation between technological change - treated as an independent variable - workplace organisation and labour relations. The publication and subsequent discussion of Braverman's Labor and Monopoly Capital reached beyond industrial sociology. The text appeared to have the potential to answer some of the limitations of the narrowly industrial literature. By giving close attention to management deployment of technology, labour process writers escaped much of the technological determinism of earlier industrial sociology and gave a more social account of technological change. Labour process writers further emphasised the social character of technology by detailed empirical studies of technological workplaces,

studies which attempted to reveal the complex integration of technological design, managerial intention, and the organisation of production. Building on the work of Braverman, such studies have provided a range of detailed analyses charting the passage of Taylorisation, job fragmentation, and deskilling in specific contexts. Yet whilst labour process writers have made a significant contribution to contextualising technology, they nevertheless appear largely to share the economic limitations of other industrial sociologists.

The graphic clarity of Braverman's concept of deskilling provided the impetus for a re-vitalisation of the sociology of work. However, the topic 'work' was consistently taken to be paid work, employment. With the exception of a few attempts to extend the concept of deskilling to domestic labour, labour process literature has been addressed almost exclusively to paid work, usually work in manufacturing contexts, often work performed by male employees.

Despite its broadly humanistic thrust, Braverman's work has been most actively taken up by writers whose concentration is on the blue collared worker. This has produced a similarly narrow focus for the conception of work and of technology within labour process analysis. The productivist emphasis has been accompanied by a view of paid work as simply exploitative, a view which appears to deny or negate the transformative aspects of work - the uniqueness of human agency, purpose and meaning in work. The concept of technology in labour process literature may also be shown to be related to paid work, and to focus

solely upon a taken for granted definition which associates technology with a subset of productive artefacts. The identification of technology with hardware and with masculine use thus becomes an unexamined strand in labour process studies. With a focus on paid manufacturing work, labour process literature fails to take account of other processes, sites, and workplaces where technology is culturally constituted - a process of constitution to which labour process studies themselves unknowingly contribute. Relations of gender and of expertise are similarly neglected in favour of a more stark characterisation of paid employment, one which emphasises management/labour conflict to the exclusion of all else. This, it is argued, produces an over-simplified conception of work - and thus of technologically related work - and substitutes a managerial determinism in place of a technological determinism. Contemporary labour process accounts contribute to a sociology of technology by focusing attention on work, yet their concept of work is a limited one. The humanistic potential of labour process analysis has been constrained by the narrowly economic perspective of industrial sociology.

CHAPTER FOUR : TECHNOLOGY AND THE LABOUR PROCESS, an elaboration of Marx.

Chapter four seeks to develop a fuller account of human work than that elaborated by contemporary labour process accounts. This chapter returns to Marx' own elaboration of labour process outlined in Capital I. A reinterpretation of Marx' concept of labour process is offered here in which Marx appears to meet the productivist and economic limitations of contemporary labour process studies and to provide the

framework for a broader conception of human work on the physical world.

Like contemporary labour process writers, Marx was clearly concerned to explore concrete circumstances in specific workplaces. Marx's substantive argument was obviously located within the nineteenth century and constrained by the circumstances of his own production. However, it will be argued that Marx's general categories of work, and of artefacts (the products of work) are not fixed in nineteenth century specifics and are capable of broader application. In particular, Marx's notion of the intentionality of the human labour process, and of the integration of human work with the physical world have the potential to transcend the mechanical concepts of work and objectivist concepts of technology to be found in contemporary literature.

Three key aspects of Marx' concept of labour process are elaborated in this chapter: Firstly, the concept of work as it relates to a wide variety of meaningful and productive human activity. Secondly, the relation between the producing work of the past and the consuming work of the present, with particular reference to the production and realisation of utility. Thirdly, the distinction between the inert physical objectified products of past labour and the conscious variability of living labour. Whilst labour process writers drew attention to the production of technology, Marx' concept of labour process embraces and integrates both producing and consuming activities in the unity of purposeful human work. There are, however, limitations to the marxian account.

Despite the broad humanistic drift of Marx' analytic account of labour process, his more descriptive passages may be seen to be firmly located within the technological optimism of the late nineteenth century. The Marxian form of that optimism, which persists to the present in strands of marxian literature, is the argument that the increased productivity made possible by technology will usher in a socialist transformation of the relations of production. Whilst it is not the central concern of this thesis to discuss whether or not Marx was guilty of technological determinism (see Rosenberg 1976), his focus is firmly on the economic relations of production, and thus, in this respect, his limitations mirror those of later labour process writers. Marx gives detailed descriptions of many workplaces, yet despite the power of his concept of labour process, the understandings which inform these descriptions are inescapably located in the nineteenth century. Thus he employs an unexamined, mechanical notion of technology, neglects ideological sites of the constitution of technology, and ignores the relations of gender and expertise which play a part in that constitution.

CHAPTER FIVE : CULTURAL STUDIES AND TECHNOLOGY

Chapter five turns to the cultural studies tradition to provide another approach to the concept of work and seeks to contribute to a more positive sociological perspective on work and on technology.

Despite their diversity writers discussed in previous chapters have reproduced an unexamined definition of technology - with a focus on paid work, an

identification of technology with hardware, and an unquestioned assumption that technology will outperform human labour. These limitations appear to derive from an economistic assumption that labour-management relations of paid production are central to an understanding of the social formation. In this chapter the thesis turns to sociological accounts which explicitly attempt to move away from a focus on manufacture and economistic explanation, to embrace not only unpaid work but work in representation. The texts discussed here may loosely be described as being within a cultural studies tradition. The focus here is particularly on writers who may be described as marxian culturalists.

Although there is no particular emphasis on technology within the tradition, the scope of cultural studies does provide the possibility of looking across a broad spectrum of human work within which definitions of technology may be produced and sustained. Marxian cultural studies writers have suggested ways in which broader notions of work and of technology might be developed. Willis (1977), for example, attempts to outline a notion of work which stresses the role of meaning as well as of wage. In opposition to the economistic notions of work to be found in labour process literature, Willis develops a concept of work which stresses worker subjectivity and workplace culture. His study suggests marked class and gender continuities between male youth culture in school and male shop floor culture. The dirt, noise and grind of unskilled manual work is, argues Willis, integral to their definition of masculinity and, as such, an aspect of the processes of cultural reproduction which leads

to working class lads choosing working class jobs. Another culturalist approach to work is evident in Janice Winship's analysis of the intersection of consumption and femininity adds a further dimension to the range of human work. The thesis draws upon another mode of culturalist theorising when it discusses Raymond Williams' outline work on television. Williams points to a notion of technology that combines the cultural with the economic. He addresses the relationships between technology, work and culture; links the emergent technical developments (in broadcasting) with notions of property and ownership and with the liberatory potential of broadcasting. Thus Williams takes an apparently technical form and subjects it to both economic and cultural analysis.

However, cultural studies is an emergent field of study and has its own substantive and methodological limitations. In practice, in a flight from the formalism of productivist accounts, cultural studies literature seems to have narrowed its focus on culture, to have reduced work "in representation" to the activities of media workers or those in subcultural contexts. The thesis argues that analysis of the production and consumption of meaning and values may be extended to a wide range of paid and unpaid human activity. It may be argued that just because work is paid and technologically related does not make it any less symbolic. Whilst cultural studies has the potential to address the ideological constitution of technology in a variety of representation practices, such work has not to date been attempted. Perhaps this silence itself speaks to the powerfully exclusive ideological constitution of technological products and

practices. Cultural studies writers then, even marxian culturalists, have failed to integrate studies of representation with work within paid production. Whilst economic relations may not be sole societal determinants, neither are they outside the production and circulation of meaning. A brief review of journalistic and sociological commentary on new technology supports this argument.

Whilst promising one avenue of escape from the constraint of productivist conceptions of technology, the ambitious character of cultural studies work provides particular emphases which may be seen to complement the formal analysis of labour process undertaken by Marx: the stress on consumption as well as production; on social divisions; on meaning and interpretation; and on the analytical importance of cultural texture and specificity. These are important elements in a fuller understanding of the range of human work. Marxian culturalist approaches however provide little explicit guidance on the specific ways in which technology, or representations of technology, may be fully explored.

An Outline of Part Three

The voice and mood of the argument changes at this point. Following from the culturalist emphasis on social divisions, on interpretation, and on specificity the discussion continues through the use of concrete examples. Thereafter, in Part III, there is reference to particular activities and workers in specific workplaces. In charting the particularity of

workplace concerns, the discussion refers to texts which fall outside sociology; they are used as a resource, to bring to the discussion views of technology which are quite absent from sociological debate.

In specific contexts the discussion continues to explore the explanatory potential of those Marxian elements of labour process previously identified. This is complemented with a marxian culturalist perspective - a broad notion of human work and an emphasis on social divisions and cultural particularity. These provide the analytical basis for the next two chapters. Focusing on specific workplaces an attempt is made to indicate the ways in which the social divisions of gender and class intersect with the material and symbolic production of technology.

The discussion highlights the difficulties encountered when challenging objectivist assumptions about technology. Such assumptions are linked to a pervasive tendency to decontextualise related concepts, such as work, skill, usefulness, and, in the case of new technology, information. In attempting to develop a sociological approach to technology which emphasises the cultural context of production and use, other sociological difficulties are confronted. Most particularly the difficulty of providing a coherent and theoretical dissection of highly integrated workplace practices - in a way that does not do violence to the specific context.

CHAPTER SIX : TECHNOLOGY AND GENDER RELATIONS

Chapter six focuses on a particular aspect of the culturalist tradition, feminism. Over the last two decades a sustained body of feminist work has explored the gender dimension of almost every taken for granted concept within sociology. Feminist re-examination has prompted radical re-conceptualisations in studies of youth, class, family, social policy, and work.

Feminist studies are especially concerned to span both paid and unpaid workplaces. All of which augers well for the study of technology. Yet even within feminist sociology technology is largely reproduced with its special status intact; even within feminist work in the labour process debate the belief in technological efficacy goes unchallenged. There are, however, a number of feminisms. And whilst the formal feminist approaches to the sociology of technology are few and disappointing, the vibrancy of other feminist work holds greater possibilities. To grasp this potential the discussion moves outside sociological theory and discusses, firstly, the conceptions of technology to be found in feminist science fiction; a second approach considers one instance of technology-related feminist practice. Reporting on the anti-sexist thrust of a Technology Network, the discussion indicates the cross cutting complexity of gender and technical expertise enacted in a workplace explicitly set up to minimise such social divisions. The discussion, although brief, tries to suggest the huge resistances which confront any attempt to change technological relations of production and expertise. Particular attention is paid to two aspects: firstly to the association, or interrelationships, between the objectification of technical work, technical expertise and masculinity;

Secondly the discussion points to the difficulty of finding a voice, a way of talking about technological work which does not reproduce those legitimacies which already surround things technical. The discussion draws upon an account offered by one participant at the Technology Network. This account is included, not for empirical purposes, but as part of an attempt to find a voice to talk about technology, in the belief that a first person account of everyday work may provide some means to subvert the constraining self-legitimizing character of technical talk. The report points to the huge resistances which confront any attempt to change technological relations of production and expertise. The report also suggests that, even whilst feminism provides some legitimacy for the incorporation of personal experience in a broader analytic framework, there are still considerable sociological difficulties in using this approach to chart the social constitution of technical expertise. The difficulty lies in combining a sociological approach to social divisions in the workplace with the more exclusive language of technical detail - yet it is in the detail itself that the relations of expertise are formed and sustained.

CHAPTER SEVEN : TECHNOLOGY, UTILITY AND WORK.

Chapter seven focuses specifically on the work of producing and using technology, here the theoretical emphasis is on marxian rather than culturalist categories, on more traditional notions of class rather than the broader notions of social divisions. However, the form of the discussion - which moves from theoretical literature to substantive accounts - reflects the culturalist concern for texture and specificity. The chapter explores the extent to which

an elaboration of the notion of utility, specifically the concepts and practices of socially useful production, may contribute to a sociology of technology.

The policy and practice of recent attempts to engage in Socially Useful Production have particular relevance for this thesis, since they offer practical examples to move away from economic and productivist notions of work and of technology. SUP initiatives have stressed usefulness rather than profitability as a criterion of production; SUP projects have been concerned to produce more useful artefacts, and the focus has historically been on that sub-set of artefacts which are conventionally defined as technology. In addition many SUP projects have attempted to change the relations of technological production, to make technical knowledge less exclusive, to democratise access to technical design, production and consumption.

The broad aim - to produce for the criterion of usefulness - seems at first sight to offer a way of inserting a humanistic notion of work into industrial production. The stress on utility appears to address the objectification associated with both commodity production and technical artefacts; to produce for usefulness implies a sensitivity to, even communication with, those who will use the product. Despite this promise, marked limitations are evident in recent attempts to engage in socially useful production, limitations which relate directly to a lack of sociological critique of technological practice.



The notion of work implicit in SUP policy and practice appears to offer a useful non-economistic conception. The pursuit of socially useful production has a warmly humanistic thrust, one which is carried over into a conception of living labour as united in progressive ideals. Yet in the literature on socially useful production the work of such socialist endeavour is itself presented in an asocial light. Social divisions of gender, class, race and age and the cultural divisions of expertise - the discords and power hierarchies of work - are minimised in the analysis. The particular account here points to ways in which relations of expertise take on a masculine character, and how class relations are flattened to sustain the optimistic rhetoric of socially useful production. The concept of technology in SUP policy and practice also appears to offer a radical alternative to profit maximising commodity production. Practical attempts to develop modes of socially useful production seem to have moved away from commodity fetishism only to construct other kinds of objectification: the concept of utility is itself fetishised, is assumed to be a fixed property of hardware - rather than a relative property of artefacts-in-purposeful-context. In one specific account the dangers of this neglect of social process and asocial conception of utility are illustrated. Through the elaboration of one practical example of SUP, the discussion points to some of the detailed intersections of technical expertise and class divisions. This example represents a further attempt to find a voice to talk about technology, to capture the workaday intricacies of technological production in

a way that avoids technical compartmentalisation and makes them available for sociological analysis.

CONCLUSION

Parts two and three thus represent a range of issues relating to the sociology of technology. The aim is simply to suggest some of the elements which may contribute towards a sociology of technology; it is not more ambitious than that since conventionally the topic of technology is constituted as an apparently asocial phenomenon. This makes it resistant to sociological analysis. The aim is to develop analytical tools to counter that resistance.

The thesis comprises these differing approaches toward a sociology of technology. A concluding chapter brings together these elements. Through a discussion of the economic and culturalist traditions embraced in the development of the thesis, the concluding chapter attempts to clarify a sociology of technology.

PART TWO

CHAPTER TWO : THE SOCIOLOGY OF TECHNOLOGY

Technology has been unevenly developed as a topic of investigation within the social sciences. Whilst there is a history (Berg, 1979), an emerging philosophy of technology (Jonas 1979), an elaborated sociology of science (Barnes and Edge 1982), and the analysis of technology in terms of social policy (Sleigh et al 1979), there are few texts which directly address the sociology of technology.

The critical theorists may arguably form the most elaborated account of technology in sociological thought. That work is not included in the developing argument of this thesis. Marcuse, in particular, presents a view of technological rationality as a source of domination, dehumanisation, and oppressive class relations.

The principles of modern science were a priori structured in such a way that they could serve as conceptual instruments for a universe of self-propelling, productive control; theoretical operationalism came to correspond to practical operationalism. The scientific method which led to the ever-more-effective domination of man by man through the domination of nature. Theoretical reason, remaining pure and neutral, entered into the service of practical reason. The merger proved beneficial to both. Today, domination perpetuates and extends itself not only through technology but as technology, and the

latter provides the great legitimation of the expanding political power, which absorbs all spheres of culture.

In this universe, technology also provides the great rationalisation of the unfreedom of man and demonstrates the 'technical' impossibility of being autonomous, of determining one's own life. For this unfreedom appears neither as irrational nor as political, but rather as submission to the technical apparatus which enlarges the comforts of life and increases the productivity of labour. Technological rationality thus protects rather than cancels the legitimacy of domination, and the instrumentalist horizon of reason opens on a rationally totalitarian society.

(One Dimensional Man, pp.158-9) (emphasis added)

Habermas has a similarly pessimistic view of technological rationality.

The progressive 'rationalisation' of society is linked to the institutionalisation of scientific development. To the extent that technology and science permeate social institutions and thus transform them, old legitimations are destroyed. The secularisation and 'disenchantment' of action-orienting world views, of cultural tradition as a whole, is the obverse of the growing 'rationality' of social action.

(Towards a Rational Society p.81)

At first sight these may be seen as a crucial contribution to the sociological understanding of technology. Yet there are significant differences

between the critical theorists' approach to technology and the project attempted here. For the critical theorists the scientific and technological project creates its own rationality - a rationality which they see as appropriate only within that sphere of activity. For Marcuse, in particular, the emphasis is on the uncivilising forces of technological rationality. For him it was crucial that the instrumentalism of technological rationality and its legitimising effect remained outside the broader social sphere.

The work of the critical theorists represents a theoretical assault on the dehumanising character of positivist science. In a similar light they saw technological rationality as representing those same tendencies to objectification and to the asocial. Their focus is on technology as ideology. The emphasis of this thesis is somewhat different. Whilst there is a version of a sociology of technology in the urgent and dire warnings of the critical theorists, the concern here is not to see technological rationality as an evil to be contained, rather to explore technology as an expression of human work in both its economic and symbolic dimensions. This thesis takes neither technology nor technological rationality as intrinsically special, but rather seeks to explore technology as any other social phenomenon - an exploration which includes the ways in which technology is treated as special in popular culture. Where the critical theorists take a given technological rationality and explore its dangerous pervasiveness, this thesis explores the cultural and lived elements which go to make up the category "technology". The concerns and evaluations here are not addressed to the dangers of technological rationality but rather

comprise a theoretical curiosity as to why the category technology has been so poorly served by sociological analysis.

This chapter then does not examine the tradition of critical theory but instead considers recent work in the emerging field of the sociology of technology, a relatively scant and eclectic literature, but one which does attempt to problematise the sociological understanding of technology.

Two recently published collections signal increased interest in the project to develop a sociology of technology. Together these texts represent the most thoughtful and elaborated sociological work in this area. The first of these The Social Construction of Technological Systems - New Directions in the Sociology and History of Technology, is located within empirical sociology and history. The second, The Social Shaping of Technology, takes a thematic approach which spans a number of sociological traditions. These collections represent the most elaborated work published in English in this field of enquiry, they directly address the sociology of technology. These two collections themselves represent two fairly distinct traditions: where the Pinch and Bijker collection draws largely on analytic frameworks developed within the sociology of science, McKenzie and Wajcman are more concerned to explore the political economy of technological change. These traditions are displayed and summarised in the discussion which appeared in Social Studies of Science Vol.16.No.2 May 1986. Pinch and Bijker concentrate on the content of technology, on the design and development of particular

artefacts. McKenzie and Wajcman see technology as one of many social processes and have recourse to more wide ranging social theory in their account of the particular instance of technology. Whilst the approach of McKenzie and Wajcman is more ideologically specific and politically focused than that of Pinch and Bijker, each collection embraces a number of competing conceptions both of technology and of sociological analysis.

There are three general reasons for including these collections in the discussion: Firstly to indicate the range and scope of contemporary work in the emergent field of the sociology of technology. Secondly to consider the potential strengths of these approaches and the insights they offer to what I have specified as necessary for a sociology of technology. The third and most important reason is more specific: these collections are included here because they represent first serious academic attempts to provide sociological accounts of technology. In diverse ways the papers explore the curious character of technology: phenomena which are commonly associated with precise and unambiguous forms of knowledge, phenomena popularly seen in relatively asocial terms. The authors develop a range of strategies to bring technology into the realm of social analysis. Yet, as we shall see, in one important respect the texts display a remarkable neglect of the social. The category "technology" is a social category yet these contemporary accounts do not give attention to the construction of this category. There is much detailed and valuable material on the ways in which particular technologies are developed, produced, adapted, deployed, yet these refer to

particular artefacts, the production and use of the category "technology" is quite absent from these accounts. The discussion then aims to demonstrate the extent to which, despite their analytical insights, taken for granted and asocial notions of technology are to be found running through this contemporary literature. This is a significant limitation. As discussed in the Introduction, to be adequate a sociology of technology has theoretically to set aside taken for granted notions of technology. An adequate sociology of technology has to address the duality of technology: firstly by developing an analysis of physical artefacts, secondly by developing an analysis of those artefacts which are included in the category "technology" - and which therefore have additional legitimation. A neglect of the social constituents of this category can direct attention away from the very roots of power and authority associated with technology.

The two collections considered below each make a contribution to a sociology of technology. Each of these collections embraces two elements: on the one hand they each contain a diversity of approaches addressing a variety of specific topics; on the other hand each collection is based upon implicitly unifying assumptions, assumptions which privilege the physical dimension of technology over its cultural constituents. The discussion will demonstrate this, it takes three sociological aspects of technology; each attempting to relate the physicality of artefacts to the cultural constitution of technology.

Technology as Hardware.

I A FIRST point to make is that these collections contain a rich theoretical diversity - a diversity which nevertheless contains an underlying implicit unity in their commonsense notions about technology as artefact, a physicalist notion of technology.

Initially the most striking thing about these volumes is their theoretical diversity. Both collections display a range of quite different theoretical positions. In The Social Construction of Technological Systems, Pinch and Bijker's contributors embrace a number of sociological approaches and an equally wide range of topics. Whilst their own, social constructivist, approach is derived from the sociology of science, they also include writers whose starting point is systems theory, and a third group who attempt to break down "the distinction between human actors and natural phenomena. Both are treated as elements in 'actor networks'" (p4).

What Pinch and Bijker refer to as "the fruitful and stimulating heterogeneity of the emerging field" is represented in their collection not only in terms of three distinctively different theoretical approaches, but also in the variety of empirical cases explored: bicycles, missiles, ships, electric vehicles, electric power systems, the cooking stove, pharmaceuticals, ultrasound, dyes, and expert systems.

In The Social Shaping of Technology, McKenzie and Wajcman display a similarly broad range of perspectives. The overall intent of their volume is to trace the "effects of social relations on technology

that range from fostering or inhibiting particular technologies, through influencing the choice between two competing paths of technical development, to affecting the precise design characteristics of particular processes or artefacts" (p.24). The diversity within the sociology of technology is revealed by contributions from a political theorist (Langdon Winner), an historian with a systems approach (Thomas Hughes), an historian whose focus is on the technology-related strengths and weaknesses of female labour power (Ruth Schwartz Cohen), and a marxist feminist whose stress is on both the economic and subjective barriers to women's participation in technology (Cynthia Cockburn).

Like Pinch and Bijker, McKenzie and Wajcman embrace a range of substantive areas. Grouped under the headings of the technology of production, domestic technology, and military technology, they include papers on the textile industry, engineering and print technologies, and clerical and domestic work with technology. The military section, moves, like the rest of the collection, from micro to macro concerns, from the M16 rifle to nuclear war.

Given this theoretical and empirical range, neither collection can offer an entirely coherent approach, but instead provides a rich survey of the directions, dissimilarities and convergences of recent writing within the sociology of technology. Each text displays the difficulties of seeking an integration between sociological approaches. This is not surprising, technology provides a particularly hard case for sociological analysis. Contributors to the McKenzie

and Wajcman collection, for example, variously see technology as the hardware of capitalist production, the hardware of domestic work, machinery, as the regulator of employees, as an expression of state power, and as having liberatory potential.

Given this variety it is often difficult to see what unites these collections. Each paper is addressed to the topic 'technology' yet each focuses on different products, sites, and practices with rather diverse theoretical emphasis. Despite this diversity the unifying notion 'technology' is treated unproblematically, the collections assume rather than argue that there are certain common features in these different accounts. Whilst it is clear that the phenomena which they address are all popularly defined as technology, there is no attempt to explore how these popular definitions are constructed. Ultimately these collections are united by an explicit resistance to accounts which rest on technological determinism. They are also united by an unstated, taken for granted notion of technology - a notion which rests heavily on technology as artefacts. The residually taken for granted view of technology has a further consequence: There are social processes which contribute toward technological hardware. There are, additionally, social processes which contribute to the category "technology". This is an analytical rather than a descriptive distinction since work in machine rooms, say, contribute to both the constitution of hardware and to the category "technology". The implicit, artefact-focused, view of technology in these collections cannot make this distinction. In consequence the social processes which are seen to

constitute technology are flattened.

The Constitution of Technology

II A SECOND point to make then is that, by neglecting to problematise 'technology', these collections ignore a number of significant practices which contribute to the category technology.

PINCH AND BIJKER

In The Social Construction of Technological Systems

Pinch and Bijker draw largely on writers from a sociology of science tradition. In an initial contribution drawn from an earlier piece in Social Studies of Science, the authors themselves put forward a trenchant position paper arguing for a sociology of technology which utilises recent work within the sociology of science. They argue that the methods used to explore the sociology of scientific knowledge may be used to understand the generation of artefacts. Their concern is to uncover the sociological elements which frame the development of technological artefacts. Their intention is to build "a sociology of technology which treats technological knowledge in the same symmetrical, impartial manner that scientific facts are treated within the sociology of scientific knowledge".

(p.406) To do this they draw upon the Empirical Programme of Relativism (EPOR), developed within the sociology of science to investigate the social construction of scientific knowledge. Within this tradition sociologists display the interpretive flexibility of scientific findings, and attempt to chart the closure mechanisms at work which solidifies interpretive variety into legitimated scientific knowledge. The method relies particularly on public

scientific controversies, and their resolution, to establish the social (rather than the experimental and physical) bases of knowledge consolidation.

The authors attempt to build upon EPOR, and a more embryonic research tradition, the Social Construction of Technology (SCOT).

In SCOT, the developmental process of a technological artifact is described as an alternation of variation and selection. This results in a 'multi-directional' model, in contrast with the linear models used explicitly in many innovation studies, and implicitly in much history technology....the thrust of our argument (is) that the 'successful' stages in the development are not the only possible ones. (Soc.Studs Sci.14, p.411)

Pinch and Bijker attempt to apply EPOR/SCOT "to show that technology, as well as science, can be understood as a social construct". (p.408) Taking the development of the bicycle, the authors present the case for a multi-directional view of development, arguing that it is "only by retrospective distortion that a quasi-linear development emerges". (p.411) Pinch and Bijker attempt to show how the differing demands of "social groups" result in the success or failure of competing models of bicycle, "to bring out more clearly the interpretive flexibility of technological artefacts". (p.411) They detail, for example, the dress problems which some bicycle designs presented to women cyclists; the safety problem of large wheeled penny farthings;

the vibration problem prior to the introduction of air tyres; and the desire for greater speed by sports cyclists. Together these groups are seen to contribute to the design of what became, over several decades, the traditional bicycle.

Attempting to bring together sociological studies of scientific knowledge and innovation studies in technology, Pinch and Bijker have made an original contribution to the development of a sociology of technology. Their argument, however, has some limitations. The first problem is that they minimise the differences between science and technology, and the nature of the relationship between science and technology. Because of its links with the sociology of science, the SCOT approach forecloses on aspects of technology which a sociology of technology should make critical. The second problem is related to this, Pinch and Bijker identify technology with physical artefacts. Presumptions about the category technology run through both these aspects of their argument. They do not question their own assumption that the bicycle, the subject of their work, is indeed technology and not simply an artefact.

Whilst Pinch and Bijker are careful to point out that the SCOT approach is less well developed than EPOR, they nevertheless assume that EPOR is appropriate for scientific knowledge, and that there is a corresponding appropriateness between SCOT and technology. In so doing they overlook significant differences. The scientific community (at least in the sense that the sociology of science regards it) is relatively clear cut, and there are discernable legitimating procedures

for scientific knowledge. Technology, on the other hand, most often has the form of commodity and thus takes its shape from a number of public and private sources. The constitutive diversity of technological products is arguably greater than that of scientific knowledge. Pinch and Bijker do not acknowledge this. They present "social groups" as functionally necessary to the development of a particular design.

In deciding which problems are relevant, a crucial role is played by the social groups concerned with the artefact, and by the meanings which those groups give to the artefact: a problem is only defined as such, when there is a social group for which it constitutes a 'problem'.

(Soc.Studs Sci.14,p.414)

The cultural constitution of the group in relation to the artefact poses a problem. Are the group presumed to act in concert, with conscious knowledge of other members? What ways do the group have at their disposal to express their "meanings" or preferences? Through market research? Through an organised biker's lobby? Or through their willingness to buy in the marketplace? If social groups simply have a voice through the price mechanism then Pinch and Bijker may have to take account of a range of other factors. For example, the market position of competing bicycle manufacturers, to identify those companies which can afford to buy market dominance through creating high costs of entry for their competitors.

We need to have a detailed description of the relevant social groups in order better to define the function of the artefact with respect to each group. Without this we could not hope to be able to give any explanation of the developmental process. For example, the social group of cyclists riding the high-wheeled Ordinary consisted of 'young men of means and nerve: they might be professional men, clerks, schoolmasters or dons'. For this social group, the function of the bicycle was primarily for sport. (Soc.Studs Sci. 14,p.415)

There appears to be two limitations to this approach. Firstly, the Pinch and Bijker argument has an overly functional character. Secondly these neglect the cultural dimensions of social groups. They appear to make a ready association of 'social groups' and functions here. It is not possible simply to read off from a group what they desire from a product. Pinch and Bijker presume a functional character to the appropriation of a design by a specific social group. They do not consider, for example, the question of how some products became desirable, nor the way in which the collective identity of a group may be expressed in common purchasing patterns. These are cultural questions which Pinch and Bijker do not address. Their conception of social group is unelaborated and, in consequence, their concept of technology determined by those groups is similarly asocial.

In this respect it could be argued that the authors have presented a rather mechanistic account; that

their approach fails to take account of the relative power differences between consumer groups; and that a more elaborated theory of consumption is needed to demonstrate the articulations between the cultural composition of markets and the equally complex processes of product generation and development.

Despite their clear emphasis on constitutive social groups, Pinch and Bijker uncritically assume a correspondence between technology and physical artefacts. Their whole approach rests on uncovering the resolution of forces which contribute to the technological product. Yet the constitution of 'technology' in general, and the meanings associated with particular products, may be said to embrace a range of social groups broader than consumers of the physical product. Conversely, the shaping forces of particular technological products cannot be read off the physical product.

Against what they see as the linear and relatively uni-dimensional analysis of scientific knowledge, often undertaken by scientists of their own activities, Pinch and Bijker attempt to embrace a wider notion of constitutive groups. Contrasting their work with that of the sociology of scientific knowledge, they note:

We think that our account - in which the different interpretations by social groups of the content of artefacts lead via different chains of problems and solutions to different further developments - involves the content of the artefact itself. Our earlier example of the development of the safety bicycle is

of this kind. Another example is variations within the high-wheeler. The high-wheeler's meaning as a virile, high-speed bicycle led to the development of larger front wheels - for, with a fixed angular velocity, the only way of getting a higher trans-lational velocity over the ground was by enlarging the radius. (Soc Studs Sci.14,p.423)

There are methodological difficulties associated with adducing the 'meaning' of artefacts for particular groups. Pinch and Bijker here reduce meaning to a matter of appropriate technological design. It appears that interpretation, meaning, and utility are seen to be artefact dependent rather than constitutive elements of product development. The role of another exogenous variable, profit, is not discussed. Technical appraisal, by differing social groups, is seen to be the sum total of the cultural constitution of the artefact. To a large extent Pinch and Bijker have abstracted technology (the bicycle in this instance) out of the social forces which give it existence. Their focus is chiefly on the function which particular designs held for specific groups over time. Revealingly, Pinch and Bijker see the process of "relating the content of a technological artefact to the wider socio-political milieu" (p.428) as a later stage in the SCOT project rather than as an integral part of the constitutive process.

By an over-reliance on methods developed to explore scientific knowledge, Pinch and Bijker are directed towards the physical artefact. The EPOR emphasis on the circumstances surrounding the production of science

and technology does go some way to re-inserting a social character into what might otherwise be taken to be the revelation of physical laws. And Pinch and Bijker go further than this; where the EPOR tradition focuses largely on the production of theories, technologies, and techniques, they attempt to take the views of users or potential users into account. However, in practice, their analysis does not move far away from the technical criteria of appraisal, appraisal that is of the physical product. They do not explore the significance which the wider consuming context has for the development of the product. Thus, in this approach, there does not seem to be scope to recognise the contribution which, for example, popular representation, market relations, or consumer subjectivities make to the constitution of technological products.

Pinch and Bijker introduce their collection by contrasting their approach - a "New Sociology of Technology" to more traditional work.

This new type of technological study can be characterised by three trends in the sort of analysis attempted. Authors have been concerned with moving away from the individual inventor (or "genius") as the central explanatory concept, from technological determinism, and from making distinction among technical, social, economic, and political aspects of technological development. The last point has been aptly summarised by using the metaphor of the "seamless web of society and technology" (p.3)

Yet to some extent the web is all too seamed: Their own treatment of bicycle technology comprises an unexamined correspondence between the sociological study of science and of technology, and an equally unexamined emphasis on technology as artefacts. When Pinch and Bijker seek to establish the contribution which social groups make to the constitution of technology, they address the ways in which such groups contribute to artefact design. One chief aim of this thesis is to present the argument that there is more to technology than design, and that meanings associated with technology derive from cultural activities beyond the design and production of a particular artefact.

Two other main contributors to the Pinch and Bijker collection diversely suggest ways in which the emerging sociology of technology might develop.

CALLON

Callon's paper, "Society in the Making: The Study of Technology as a Tool for Sociological Analysis" starts by recognising the split between technical innovation and commercial development which characterises so much commentary on the sociology of technology. Yet, argues Callon, there is much to be gained from seeing both as an integrated sociological event. Callon's approach then suggests one means of embracing a wider set of social actors than those explicitly concerned with the physical product. Taking one particular example, research into an electric car by engineers at Electricite de France (EDF), Callon argues that the work of the engineers provides a methodological model for sociologists.

...it is often believed that at the beginning of the process of innovation the problems to be solved are basically technical and that economic, social, political, or indeed cultural considerations come into play only at a later stage. However, more and more studies are showing that this distinction is never as clear-cut. This is particularly true in the case of radical innovations: Right from the start, technical, scientific, social, economic, or political considerations have been inextricably bound up into an organic whole. Such heterogeneity and complexity, which everyone agrees is present at the end of the process, are not progressively introduced along the way. They are present from the beginning. Sociological, technoscientific, and economic analyses are permanently interwoven in a seamless web. Using the case study of an innovation I show how it is possible to use this characteristic in order to transform the study of technology into a tool for sociological analysis; this leads to a new interpretation of the dynamics of technology. (p.84)

Callon points to the technical, governmental, industrial, and market factors which the EDF engineers necessarily took into account in their proposals for the radical break represented by the electric car.

... the engineers left no stone unturned. They went from electrochemistry to political science without transition. The analysis of French society that they proposed was both

remarkably incisive and fully elaborated. Five years after the 'great cultural revolution' of May 1968 and one year before the first oil crisis, they outlined the course of an evolutionary movement that would propel French society from industrial to the post-industrial age. (p.86)

In an attempt to transcend any distinction between social and technical spheres of activity, Callon proposes the concept of 'actor network' to embrace the many interacting variables which constitute the processes of technological product development. Callon's actors include electrons, catalysts, accumulators, users, researchers, manufacturers, and ministerial departments defining and enforcing regulations affecting technology. These and many other actors, he argues, interact through networks to create a coherent actor world.

By seeking to refute the technical/social distinction, Callon here appears to do violence to both. The action of electrons and accumulators is neither autonomous nor purposeful. The actions of consumers cannot be seen in simply mechanical terms, but subject to consciousness, intentionality, and the wider cultural and political context of meaning. The work of engineers is no more integrative, nor outside technical/social divisions of labour, than that of sociologists.

Callon's work highlights two pervasive difficulties in sociological approaches to the study of technology: First the tendency to bracket off physical events as if

they were not dependent on human action; and secondly, the tendency of conceive of human action as if it were to be compared to that of physical phenomena.

Examples of these tendencies in popular representation are the presentation of new information technology as self-acting and 'intelligent' (Feigenbaum and McCorduck 1983) and the description of human cognition in terms of computer processing (Boden 1977).

A more major difficulty with Callon's paper is his emphatic insistence that engineers take societal features into account in their design activities, "they went from electrochemistry to political science without transition". Callon suggests that engineers engage in sociological work and that, in consequence, sociologists could usefully adopt this broad model of enquiry in their exploration of technology. There are, however, difficulties associated with using an engineering approach as a model for sociological enquiry. Clearly engineers do work with a model of society, they would be unable to do their work without some social framework for their productive activities. Equally a sociologist might embrace engineers' accounts in their analysis of technological innovation. (Indeed a sociological account of technology could turn to engineers' models of their work as data, as a first order construct for sociological enquiry). We cannot however assume that the modes of logic and tools of enquiry are the same for engineers as they are for sociologists. There are distinctions to be made between the conceptual frameworks of engineers and sociologists which cannot be dissolved by pointing to the fuzzy and shifting parameters of their actual work. Callon does not acknowledge the construction of and

persistence of the social/technical divide at the level of theory. In consequence, in his account of engineering innovation, he cannot acknowledge the extent to which engineering ideologies contribute to the construction of the category "technology", or equally the ways in which social theory and popular representation may contribute to the engineers notion of car and car design. Callon's work usefully indicates the shifting boundaries of the actual work of engineers, and makes a valuable attempt to broaden the notion of engineering work to embrace a wider range of social considerations. What he cannot do is to recognise the significance of non-engineering work in the constitution of technological products.

HUGHES

A third contribution to the Pinch and Bijker collection comes from Thomas Hughes. Using a systems approach he argues that the labels of science and technology have no real purchase in the many case studies that he cites. In a refreshingly empirical approach he emphasises the 'messiness' and complexity of actual technological systems compared with the purity of abstraction.

Technological systems contain messy, complex, problem-solving components. They are both socially constructed and society shaping. Among the components in technological systems are physical artifacts, such as the turbogenerators, transformers, and transmission lines in electric light and power systems. Technological systems also include organisation, such as manufacturing firms, utility companies,

and investment banks, and they incorporate components usually labelled scientific, such as books, articles, and university teaching and research programs. Legislative artifacts, such as regulatory laws, can also be part of technological systems. Because they are socially constructed and adapted in order to function in systems, natural resources, such as coal mines, also qualify as system artifacts. (p.51)

In an attempt to demonstrate the ordered interrelatedness of physical products and social processes, Hughes isolates seven activities, any of which may predominate at any time in a technological system.

The history of evolving, or expanding, systems can be presented in the phases in which the activity named predominates: invention, development, innovation, transfer, and growth, competition, and consolidation. As systems mature, they acquire style and momentum. ... The phases in the history of a technological system are not simply sequential; they overlap and backtrack. After invention, development, and innovation, there is more invention. Transfer may not necessarily come immediately after innovation but can occur at other times in the history of a system as well. Once again, it should be stressed that invention, development, innovation, transfer, and growth, competition, and consolidation can and do occur throughout the history of a system but not necessarily in that order. (pp.56-57)

Hughes takes each of these activities in turn and, drawing on a wealth of historical detail, illustrates the ways in which that activity relates to other social phenomena. So, for example, invention is seen to embrace the invention of holding companies as well as electric light bulbs; The notion of the great inventor is put in historical context of similar and parallel work; Armaments contracts are related to commercial security and the opportunities for creative work.

Hughes argues compellingly for the social history of technology to be recognised, yet his systems approach creates a curious tension away from the particular and the historically specific. Whilst his formal analysis suffers from the limitations of functionalist analysis, his elaboration of that analysis provides strong evidence of the social integratedness of technological production. His account provides persuasive historical evidence to refute a notion of a uni-linear development of a physical product, or the separation of technical events from other supposedly non-technical events. There are strengths and limitations to this approach: he regards all phenomena as system elements and thus is unable to consider the notion of destabilising power, or of significant influences which come from outside his prescribed system. In particular, Hughes' approach cannot address the question of how technology comes to be regarded as 'special', or how technologically related work is privileged within divisions of labour. Yet, paradoxically, the emphasis on historical detail in Hughes' work, does appear to provide a means of making technology ordinary, of regarding technology as simply another element in a social system. By looking at

historical detail Hughes avoids treating technology as an unexplained black box, or as an exogenous variable impacting on events. In this way he addresses the social/technical divide in sociological analysis. What his approach cannot do is to recognise that although technology is available for routine sociological analysis, in this case systems theory, nevertheless technology is, in many other contexts and respects, treated as if it were far from a routine or sociological phenomenon. Thus Hughes is unable to consider the ways in which technology is treated differently, or the extent to which that different treatment is derived from, and related to, the ideological power associated with technological products, from workplaces far removed from the production of technological artefacts.

The three papers from The Social Construction of Technological Systems mark out the territory of the Pinch and Bijker "new sociology of technology". They are exploratory, innovative, and characterised by a sense of common purpose rather than a coherent theoretical position. Each draws attention to the great difficulty of giving a sociological account of events which have been constituted as technical, and asocial. Each account demonstrates a neglect of the processes which constitute the category "technology", and thus they are unable to take account of the work of symbolic production, work which arguably takes place as much in technological workplaces as elsewhere.

MCKENZIE AND WAJCMAN

The second collection to represent current thinking within the sociology of technology comes from the Open

University Press. In The Social Shaping of Technology: How the Refrigerator Got its Hum, McKenzie and Wajcman take a refreshingly broad view of technology, embracing physical hardware, the associated human activities, and technological knowledge. They draw attention to the pervasiveness of technological determinism.

In the most common version of technological determinism...scientists discover, technologists follow the logic of those discoveries in turning them into new techniques and new devices, and these techniques and devices are then introduced into society and have (often unpredicted) 'effects' - that is the most widespread account of how technology comes to be an independent factor.
(p.4)

McKenzie and Wajcman rest their refutation of technological determinism on the thesis that "the characteristics of a society play a major part deciding which technologies are adopted" (p6), and they provide examples of different developmental paths for the same technology. In their refutation of technological determinism, McKenzie and Wajcman run the risk of importing a technological determinism of their own. By neglecting to problematise the category technology, a different kind of technological determinism slips back again into the argument. They present a model of society which 'shapes' technology down one of several developmental pathways. But in that model technology is taken as given, it is assumed that we know what technology is and the analysis focuses on what kinds of technology are shaped by this or that developmental

circumstance. A deeper critique of technological determinism would conceptualise this issue rather differently, embracing not only the physical, institutional and economic constitution of technology but its ideological and symbolic constitution as both product and as social category. McKenzie and Wajcman have neglected to give analytical weight to the cultural constitution of technology. In consequence their discussion about the social shaping of technology does not address significant areas of social life which shape technology. They do not address, for example, those activities which define some artefacts, some processes, as technology. Or, for another example, they do not address the ways in which the production and reproduction of imagery contributes to what passes for technology. (A note of qualification is needed here. It is not the intention of this discussion to so emphasise the cultural and representational that the physical, artefactual aspects of technology are defined away altogether. The intention here is simply to call attention to the equal danger of ignoring the social shaping of the category technology - and, in consequence, to neglect the representational work of those who do not have direct physical contact with the artefact.)

The authors rapidly discuss and dismiss crude forms of technological determinism, to arrive at the major thrust of the volume, the pursuit of the question "What shapes technology?". Their focus then is not on impacts, nor innovation studies, nor on the relation between science and technology, but on the many social forces which constitute technology. Like Pinch and Bijker, McKenzie and Wajcman are concerned to

demonstrate the multi-faceted character of technological shaping. They include innovative and challenging writings in this field - many of their contributors are discussed elsewhere in this thesis. The very structure which they adopt, however, indicates their awareness of the considerable theoretical difficulties posed by a sociology of the technical and social processes which comprise technology. By differentiating between manufacturing, domestic and military sites of technological shaping, McKenzie and Wajcman are able to recognise the differing productive relations which obtain in these workplaces. This is a major strength in their approach since, by this means, they avoid any suggestion that technological artefacts have existence outside of the contexts of production and use. The limitation of this approach is that discussion is confined to workplaces where conventionally defined technological products and processes are to be found. How these phenomena came to be defined as "technology" at all is unaddressed. This silence is telling, suggesting an implicit hardware-related notion of technology. The emphasis on hardware, on technology as physical object, recurs in these collections. The absence of a problematised approach to the category "technology" confirms this focus. The point is not to disregard or deny the physicalism of technology but rather to recognise those workplaces, those cultural practices which give meaning and symbolic value to artefacts. It will be argued that social constitution of technology occurs not only in technical workplaces but also in important sites like schools and cinemas and copy rooms. This is not to suggest that some workplaces are concerned with symbolic production whilst others are simply concerned

with physical work. The cultural production of technology no doubt occurs in manufacturing, domestic and military contexts but it may also be seen to occur in other constitutive workplaces, where the very ascription "technology" is produced and reproduced. It is this dimension of social action which is in danger of neglect when a hardware focused, taken-for-granted notion of technology is allowed privilege.

It will be as well to emphasise the point: It is not the intention here to suggest that work in representation is prior to, or more significant than, work directly related to technological products and processes. It is the intention to point to the rich interplay of ideological, economic, and inter-subjective elements which constitute technology. There are however, no ready-made sociological tools of analysis which coherently combine the representations of technology, with the economic shaping of technology, together with an ethnography of expertise and gender relations in technological workplaces. This is a difficulty which not only shapes The Social Shaping of Technology but provides the theoretical context for this thesis.

The physicality of technological artefacts.

III THE THIRD point to make is that there are few tools available to give a sociological account of physical objects, and of the way objects become technology.

Three writers in the McKenzie and Wajcman collection, Winner, Doorly, and Cooley, each attempt to address the physicality of technology whilst retaining an

analytical purchase on the social character of its use. Winner's and Doorly's arguments are outlined below, the ways in which Cooley's ideas have been used receives fuller attention in chapters six and seven. A further discussion of the writing of Cooley forms Appendix VI.

Langdon Winner's paper "Do Artefacts Have Politics?" explores the ways in which particular technologies, by which he means "all of modern practice artifice" (p.28) have particular properties 'in themselves' (p.26). Resisting simple notions of social and technological determinism he offers the view that 'those who have not recognised the ways in which technologies are shaped by social and economic forces have not gotten very far' (p.26-27). However, he cautions

But the corrective has its own shortcomings; taken literally, it suggests that technical things do not matter at all. ... The social determination of technology is, in this view, essentially no different from the social determination of say, welfare policy or taxation. (p.27 original emphasis)

Winner outlines examples of the ways in which artefacts can be seen to have political properties, that is to 'refer to arrangements of power and authority'. He argues that the design of technologies can be undertaken to achieve a particular social effect (for example to reduce wages) and that the design of technologies - once in existence - carry with them a practical necessity to meet certain social and material conditions (for example the centralisation of power and the increase in security associated with nuclear

power). Winner is one of the few writers to draw attention to the physicality of technology as a sociological problem. The thrust of his work is on the consequence of technological development. In this respect he offers a sensitive account which does not simply address the "impacts" of technology. Winner's account does recognise the social origins of technology but, he argues, once formed technological artefacts themselves take on social force. However, Winner does not address the ways in which technological artefacts become objectified and detached from the human labour and purposes of their generation, this is not a part of his account. Later chapters of this thesis draw attention to objectification as part of the sociological problem of dealing with the physicality of technology.

In a similar vein Myra Doorly, in her paper "A woman's place: Dolores Hayden on the 'grand domestic revolution'", gives more attention to the physicality of technology than to broader social relations. She describes moves towards the socialisation of domestic work which were promoted by Dolores Hayden and others in the United States during the early part of the century. Doorly reproduces uncritically the belief that the socialisation of domestic work, and the decrease of women's isolation and marginalisation, is dependent upon architectural changes. Whilst Doorly's focus is on the liberation of women's work, in her historical example she nevertheless presents a new order of technology of domestic production as the key to the equalisation of women.

Things, objects, artefacts, make difficult subjects for sociological analysis. The apparent integrity of objects makes their sociological disaggregation awkward and unwieldy. We are used to treating things as physically fixed, we are unused to treating things as sociologically dynamic. Things which carry the ascription "technology" provide yet another order of difficulty. The apparent certainties of the hard sciences deter the ambiguity and many-layered character of social analysis. Whilst Winner confronts the difficulty squarely, Doorly resorts to a different kind of physical determinism, appearing to suggest that new artefacts alone can produce more desirable working relations. By this means both Doorly and Winner not only privilege the technological artefact but at the same time negate the constitutive social origins of technological artefacts.

CONCLUSION

Taken together the two readers, The Social Construction of Technological Systems and The Social Shaping of Technology represent sensitive work which make important first steps in this area. They are attempts to develop a kind of approach which is not technological determinist. They have, however, significant limitations which this thesis will attempt to resolve. The considerable overlap in their contributors points to the scarcity of work in this field. Both volumes move away from technological determinism and presumptions of the asocial independence of technology in social change. Both resist notions of scientific determinism, where technology is seen to be simply the application of

scientific work. Both, by reference to a wealth of historically specific detail, attempt to incorporate the plethora of constitutive processes which shape technology. Both volumes thus contribute to the process of taking technology off of a pedestal of epistemological privilege of specialised knowledge. These are their strengths, yet both volumes have significant silences: The first of these is that amid a wide range of topics and theoretical approaches, there is no discussion on how these phenomena come to be defined as technology. On the face of it there is nothing obviously intrinsic to either artefacts or contexts which determines what shall be called technology. The constitution of the social category technology is a matter for sociological analysis. Yet the two collections do not recognise nor address this need, in consequence a commonsensical notion of hardware is allowed privilege.

The second silence follows from this. These collections present accounts of the physical and material constitution of technological artefacts. Yet I have presented the view that artefacts are also repositories of meaning and values, in this sense they are cultural products as much as any other named phenomena in society. McKenzie and Wajcman recognise the interrelationships between technology, productivity and social control. In this respect they see artefacts as repositories of meaning and value. Yet in another respect they neglect the symbolic dimension of work and of artefacts. Those who work in popular media, say, arguably contribute to the definition of technology, as do those who work in domestic, commercial and manufacturing contexts. Each

constitutive practice is available to both material and representational analysis. Yet in the texts outlined here these workplaces are lost from the account of the sociology of technology. This omission hits at the heart of a sociological account of technology. Technology appears to be exclusive, mystifying, unavailable for social examination. The view is presented here that a sociological account of this exclusivity will reach beyond technical workplaces to explore the ways in which the ideological character of technology is framed. This means exploring a number of different social practices, since the exclusivities of the technological processes are not necessarily nor solely the product of technologically related workplaces, as conventionally defined. This thesis aims to cast its exploratory net to a wider variety of workplaces.

A third silence relates to the treatment of the physical. I have argued that few writers have recognised that this presents a sociological problem. Whilst there are analyses of the way particular technological artefacts come to be, once in existence the apparent fixity of physical objects is presumed rather than held up for sociological enquiry. This is strange since acknowledging that technology has a material form does not necessarily lead into the determinism of physical laws. A sociological analysis of physicality is still possible. In the same way that technology is taken as given rather than as a constructed social category, so too the physical form of artefacts is assumed rather than brought into question. Of course artefacts are physical, but things are never simply things. The sociological

problem is, firstly, how to develop an analysis of things which acknowledges their physical and changing cultural existence. The second part of the sociological problem is to explore the ways in which technology relates to artefacts, to recognise that there is no identity between technology and artefacts.

These three silences in contemporary attempts to develop a sociology of technology provide some clues to a fuller account. The next chapter attempts to add to this by considering a literature where technology, although central, is not addressed so directly or explicitly - the technology of production in the labour process debate.

CHAPTER THREE : TECHNOLOGY AND THE LABOUR PROCESS.

The project of this thesis is to propose some elements for a relatively neglected area of sociological enquiry, the study of technology. In the last chapter texts directly addressing the sociology of technology were discussed. These were found to have a taken for granted, object-focused notion of technology. This chapter forms a rather different attempt to isolate some elements toward a sociology of technology. It was proposed, in the Introduction, that a major impediment to a sociology of technology has been the ways in which technology is treated as 'special' and socially exclusive. One of the tasks toward a sociology of technology must be to take technology off this discursive pedestal. It was proposed that one approach to revealing the ordinariness of technology may be to consider technology as an expression of human work. This chapter addresses that task by exploring work, specifically the marxian concept of labour process first made popular by Harry Braverman in Labor and Monopoly Capital. Unlike more mainstream industrial sociology, Labor and Monopoly Capital does not simply describe the technology of production but rather takes technology to the centre of the analysis. For this reason Labor and Monopoly Capital presents itself as a possible source to progress this project, as a text which has within it both an explicit and an implied model of technology.

The text of Labor and Monopoly Capital forms the central focus of this chapter. Braverman's focus is on changes in work and work organisation in the

twentieth century. He uses marxian tools of analysis to explore managerial deployment of the technology of production. Labor and Monopoly Capital is considered here then, firstly because it attempts to make technology an integral part of a sociological exploration; and secondly because Braverman's focus on human work holds the promise of some concrete, specific practical purchase on technology.

The discussion proceeds as follows: A first section explores Braverman's concept of work, a second section considers his concept of technology. The strengths and limitations of Braverman's thesis are set out, as they relate to a sociology of technology. A third section discusses the work of David Noble, a labour process historian who at least partially overcomes the limitations of Braverman. A concluding section assesses the extent to which contemporary approaches to an understanding of the human labour process contribute to a sociology of technology.

As a preface, the sections below outlines the background and the relevant strands of the Braverman thesis.

Background to the Labour Process Debate.

Until 1974 the processes and products of technological practice seems to have received little sociological attention. Despite the existence of a social history (see, for example, Berg 1979) and an emerging philosophy of technology (Jonas 1979), sociological commentary on technology was chiefly confined to two areas of work. Firstly, the technology of production, described in industrial relations literature; secondly

technology as an object of theoretical concern for marxian writers. In the former detailed descriptions of technological hardware and processes have provided a backcloth against which management and the labour force are seen to conduct their formal and informal negotiations. The historical and cultural genesis of technological practices, of tools, machinery, and technique, has not been seen as a significant topic for industrial relations analysis. In the latter, technology has been a central concern to marxian theorists where, as Reinfelder (1980) has detailed, a belief in technological change as progressive, as a motor of revolutionary change, has been a constant theme in marxian writings. Despite the centrality which Marxists accord technology, the development and deployment of specific technologies, of particular techniques and associated social relations, has been seen as less important than the irresistibility of technological change in general and its relation to revolutionary change.

Whilst these two traditions continue, neither bring great sociological insight to bear on technological practices themselves. Both industrial relations literature and marxian social analysis tend toward a determinist view of technology, neither explore beyond the economic determinants of technological practice. Two events during the 1970s brought technology to the forefront of sociological agendas: the first of these was the publication in 1974 of Harry Braverman's Labor and Monopoly Capital, the second, the publishing explosion which accompanied the development of new information technologies. At a time of marked economic recession both events prompted a resurgence of

interest in the sociology of work, unemployment, and changes in labour markets and labour processes. The role of technology, especially of new technology, featured prominently in these debates.

On its publication in the UK Labor and Monopoly Capital swiftly became a hugely popular text, it was taken up not only by sociologists but also by journalistic and trade union commentators. During the late 1970s popular representations of new technology and the significance of Labor and Monopoly Capital appeared to converge. Braverman's deskilling thesis and alarm about the "new technology" became intertwined: "New technology" was presented in populist and often sensationalist terms. Pessimistic forecasts, made by commentators from across the political spectrum, predicted massive unemployment (Jenkins and Sherman, 1979, CSE Microelectronics Group 1980), and even the end of the working class (Gorz 1982). Against this despair, others foretold the rise of a post-industrial or information society (Stonier 1982) and of the possibilities for artificial intelligence (Michie 1974, Feigenbaum and McCorduck 1983). The incoming Conservative government in 1979 promoted the wealth-producing possibilities of the new technology and declared an IT'82 Year to provide government support for industries adopting these new "heartland technologies". Representatives of both those who stood to gain and those who stood to lose employment saw the new technologies unquestioningly as a radical departure in terms of combining increased processing power with phenomenal decreases in price and thus in unit cost. (These events are discussed in fuller detail with specific reference to state funding of microcomputers

in education in Appendix I.)

Government funded hype promoting the vast wealth-producing possibilities of the new technology was in marked contrast to more sober French government-commissioned Nora report, which drew special attention to the potential of microelectronics drastically to reduce employment levels. Labor and Monopoly Capital provided a ready-made analysis for this apparently superhuman new technology. In place of the widely divergent optimistic and pessimistic accounts of the new technology, Labor and Monopoly Capital provided an easily accessible grid through which to view the revolution which appeared to be occurring.

Writing in the early 1970s Braverman did not address the cultural event of "new technology". Nevertheless his timely publication provided a means of analyzing these mystifying developments in computing, microelectronics, and telecommunications. The "new technology"/deskilling couple seemed tailor made for each other. They proved to be mutually influential: deskilling was seen as a key to understanding the new technology, and new technology appeared to provide a ready confirmation of the deskilling thesis. Where "new technology" was associated with increasing productivity/unemployment, Braverman's theme was the progressive homogenisation and weakening of the working class, through the erosion of skills, by the Taylorist use of machinery. Neither approach questioned management's ability to bend technology to meet these remarkable claims.

So far as "new technology" is concerned this uncritical stance seems to stem in part from a popular tendency, in both journalism and sociological commentary, to treat the new products as a self-contained, uniform phenomenon, isolated from other societal and organisational influences and having an inexorable momentum of their own. (Examples of the characterisations of "new technology" to be found in journalistic, popular, and Trade Union literature are given in Appendix IV.) As for sociological commentary, that too in large part focused on discerning or predicting the social consequences of new technology, without challenging the presumed means to that end, the capacities of the new technology itself. See, for example, Forester's revealingly entitled 1980 collection Microelectronics Revolution: The Complete Guide to the New Technology and its impact on Society.

Whilst providing a theoretical base from which to understand 'new technology', Braverman's Labor and Monopoly Capital reawakened interest in, and gave an interpretation of, Marx's account of labour process detailed in Capital I. Braverman's text re-opened a consideration of Marx's concept of labour process. He provides an interpretation which, ironically, is wider than the one which, celebrating Labor and Monopoly Capital, became part of social science literature. This chapter will discuss the concept of labour process elaborated by Braverman; chapter four returns to Marx' own text to outline an interpretation of labour process which differs, in emphasis, from recent labour process analysis.

THE LABOUR PROCESS DEBATE

In Labor and Monopoly Capital Braverman was concerned to chart what he saw as historic tendencies in the mode of production, expressed in monopoly capitalism. He describes how Taylorist forms of management, and the processes of specialisation, fragmentation, and deskilling represent a significant shift of power in favour of management. Through a discussion of scientific management, Taylorism, and deskilling, Braverman paints a picture of increasingly alienated labour under capitalist relations of production; of detailed human labour which is largely indistinguishable from mechanical forces of production; and a shift from what he saw as the creativity of craft work to loss of control and worker satisfaction.

For Braverman, work within capitalist relations of production is shaped by three organisational elements: the necessity for capitalist management to control all aspects of the labour process; the management thrust to separate conception and execution of work; and the historic tendency to specialisation and detailed fragmentation of work.

The post Braverman debate has touched upon a number of issues relating to paid employment. In particular Braverman brought a new perspective to the study of work organisation, and to the concept of skill. Since the publication of Labor and Monopoly Capital the social construction of skill, the relation between skill and sexual divisions of labour, and the extent to which deskilling or upskilling is (or is not) taking place have become major areas of contention in

sociological literature. Indeed the cultural phenomenon of "new technology" in popular commentary has been matched by the quantity of the more specialist post-Braverman discussion, debate, and publication.

There has been much lively debate around Braverman's thesis, and a number of significant criticisms emerge from commentary of Labor and Monopoly Capital. An initial wave of critique focused upon Braverman's concept of class, especially his apparently objectivist conception of a working class; and his characterisation of management power and practice, especially his overconcentration on Taylorism. Writers argued for an extension of his work to include working class consciousness and struggle.

A second wave of debate attempted to re-insert class consciousness and subjectivity by recognising worker resistance (Edwards 1979, Friedman 1977); whilst a third wave of post Braverman debate questioned the inequalities of power in work relations posited by Braverman (Elger 1979,1982) The thrust of these later discussions has been to recognise work organisation as an outcome of labour/capital struggle.

Other criticisms have focused upon Braverman's overconcentration on management's labour problem, his association of skill with craftsmen, and his treatment of management as omniscient, as able to achieve total control (Wood and Kelly 1982).

These debates however all centre on matters of work organisation. Despite pages of citations, there has

been very little development of Braverman's account of technology. Paul Thompson's text The Nature of Work: An Introduction to Debates on the Labour Process meticulously covers all aspects of the labour process debate, yet the issue of technology does not appear. Whilst the assumption of all labour process debate is the non-neutrality of technology, there has been virtually no labour process account of technology in post Braverman explorations. There have been detailed accounts of the speed of technological innovation and its impact on employment. Some of these (McLoughlin et al 1987) entail lengthy descriptions of technical detail, an approach which does little to provide a sociological account of that technology. In all these approaches technology tends to be viewed as a fixed and management-given entity which either determines the design of jobs or, at least, sets specific constraints on the choices available in the decision-making process. A remarkably few texts attempt sociologically to address the ways in which technology is formed and used in workplaces. (Cooley 1980, Noble 1979, McKenzie and Wajcman 1985 are exceptions, all attempt such analysis).

Despite these reservations, Braverman has inspired a number of detailed and interesting workplace studies (CSE 1980, Levidow and Young 1981,1985, Wood 1982, Heron and Storey 1986). In an empiricist tradition, researchers have employed Braverman's deskilling thesis in an unproblematic way. They have presumed that deskilling is sought by managements. They have used the thesis to examine the particular ways in which changes in processes of production are functional to the interest of managements. They have charted job

re-design in specific workplaces, and examined the changing pattern of skill definitions. Braverman's work has also contributed to a more general concern for the sociological study of work itself including unemployment, economic and sexual divisions of productive and reproductive labour, and an interest in labour markets. The study of work, and non-work, also fostered a closer examination of the relations between education, training, and employment (Willis 1977, Finn 1987, Purcell et al 1986a, 1986b).

The labour process debate marked a shift in sociological views of technology. In so far as there was any sociology of technology it was found in industrial sociological literature, when it was assumed to be somehow outside the social relations of the workplace. From that unexplored assumption Braverman, and subsequent labour process writers, began to view technological change as a problematic and contested terrain: if the development and deployment of technology is seen to be bound up with the interests of management, then presumptions of the historical independence or neutrality of technological change are necessarily called into question. It could be argued that one of Braverman's little acknowledged achievements has been the presentation of production technology as shaped by the needs of the deploying group rather than by 'progress' or autonomous development. Braverman presents machinery as a major means of implementing Taylorism.

Machinery offers to management the opportunity to do by wholly mechanical means that which it had previously attempted to do

by organizational and disciplinary means. The fact that many machines may be paced and controlled according to centralized decisions, and that these controls may thus be in the hands of management, removed from the site of production to the office - these technical possibilities are of just as great interest to management as the fact that the machine multiplies the productivity of labor. (Braverman p.195)

Labor and Monopoly Capitalism represents a detailed elaboration of this thesis.

For Braverman, the modern technology of production can only be understood in relation to changes in the relations of production within monopoly capitalism. Braverman makes explicit his commitment to this Marxian approach.

Machines may be defined, classified, and studied in their evolution to any criteria one wishes to select: their motive power, their complexity, their use of physical principles, etc. But one is forced at the outset to choose between two essentially different modes of thought. The first is the engineering approach, which views technology primarily in its internal connections and tends to define the machine in relation to itself, as a technical fact. The other is the social approach, which views technology in its connections with humanity and defines the machine in relation to human labor, and as a social artefact. (p.184)

Braverman's position is clearly the second of these. He "defines the machine in relation to human labour". This close analytical association of machinery and human work provides some insights into how technology might be seen as a sociological phenomenon.

Firstly Labor and Monopoly Capital has stimulated an awareness of, and critical attitudes towards, the pervasiveness of technological determinism in social commentary. Secondly Braverman has attempted to re-insert technology back into social relations, and to make human work central to this attempt. Thirdly Braverman revived interest in Marx's concept of work; of particular interest here are the concepts which refer directly to the work associated with technology, those of dead and living labour. The limitations of Labor and Monopoly Capital follow, as we shall see, directly from these positive features.

Whilst it is important to acknowledge that Labor and Monopoly Capital represents a significant achievement in pursuing a socialised, rather than technicised, view of the machinery of production, within that acknowledgement the chapter will argue that Braverman's thesis has two major limitations: First, whilst Braverman does have a politicised view of technology, his politics of technology is largely centred on who owns or controls the hardware of production; in this respect his account replaces technological determinism with another determinism, the deskilling thesis appears to evoke instead a managerial determinism which finally leaves technology intact and unexplored. What is required, I shall argue, is an approach which tries to

take account of the constitutive politics of technological development and deployment. Secondly, whilst Braverman does give valuable priority to the marxian concept of human work, and his account does offer a potential means of theorising technology in terms of past and present work, yet Braverman's notion of work is itself limited by a narrow and assumed notion of worker - with a consequent narrowing of his concept of technology. The next two sections explore the strengths and limitations of Labor and Monopoly Capital for a sociology of technology; consideration is given firstly to Braverman's concept of work and secondly to his concept of technology.



I BRAVERMAN'S CONCEPT OF WORK

Braverman presents the view that the technology of production has been developed to meet the Taylorist aims of management. This approach places technological change squarely within the contested terrain of labour/capital relations. Thus Braverman not only presents technology as a social phenomenon, but he is quite specific about the particular social relations which are determinate. Braverman's concept of technology is, then, shaped by his concept of work and of capitalist working relations. His view of work, however, is a particularly focused one.

Writing within the North American tradition of Baran and Sweezy, Braverman's marxism is more concerned with the role of corporations, he has a less elaborated sense of active class relations than his European counterparts. Within the United Kingdom the sociological study of work has been largely concerned with objectivist descriptions of paid employment. As McNeil (1981) points out in the Radical Science Journal, "the marxist tradition has been characterised by its belief that it is not work per se which merits attention, but rather the purchase which the study of work provides both on the features of capitalism and on relevant forms of socialist struggle" (p.111). Later labour process writers are firmly within this tradition. Braverman acknowledges his debt to the economists Baran and Sweezy and, within that tradition, has sought to make a contribution to the analysis of the next stage of capitalism. An understanding of capitalist relations of production is his chief aim; and "work" is largely identified with paid employment,

with skilled occupations, and often with work of a directly physical kind. In a similar vein the majority of subsequent labour process studies have been addressed to men's rather than women's work, in profit seeking rather than public service contexts, and in manufacture rather than in professional, managerial or administrative contexts. The concept of work in labour process literature has thus been sharply narrowed by this close identification with particular characterisations of shop floor employment.

Braverman's concept of work assumes a determinate relation between paid, profitable work in industry and work in the rest of the economy. He has no discussion on the differences between work within the public and private sector since it is assumed that the public sector follows from profitable work. The thrust of Braverman's thesis is that he is addressing the key area of work and the key actors in the social formation. Braverman's concept of work embodies a strongly taken for granted view of the worker as paid, as productive, and as engaging in work of a directly physical character. Each of these aspects provides an important, if largely unexplored and assumed, strand in the development of Braverman's argument. Each is discussed below, together with a section considering the role of purposeful human work in production.

PAID WORK

The political economy of Braverman's focus would necessarily lead him to emphasise paid work. But he goes further and sees the relations of paid production as determining all else. He does not acknowledge other sets of determinations.

Whilst the major part of Braverman's work is addressed to paid work in profit seeking industry, his brief consideration of the question of unpaid domestic labour provides an illuminating shaft; and his analysis of domestic labour gives some clue to his restricted concept of work in paid contexts.

Braverman's conception of working time in the home is of a form of work shaped by the domination of capitalist relations of production and commodity consumption.

In a society where labor power is purchased and sold, working time becomes sharply and antagonistically divided from nonworking time, and the worker places an extraordinary value on this "free" time, while on-the-job time is regarded as lost or wasted. Work ceases to be a natural function and becomes an extorted activity, and the antagonism to it expresses itself in a drive for the shortening of hours on the one side, and the popularity of labor-saving devices for the home, which the market hastens to supply, on the other. But the atrophy of community and the sharp division from the natural environment leaves a void when it comes to the "free" hours. Thus the filling of the time away from the job also becomes dependent upon the market, which develops to an enormous degree those passive amusements, entertainments, and spectacles that suit the restricted circumstances of the

city and are offered as substitutes for life itself. Since they become the means of filling all the hours of "free" time, they flow profusely from corporate institutions which have transformed every means of entertainment and "sport" into a production process for the enlargement of capital.
(p.279)

Here Braverman contrasts work as a "natural" function with the de-humanising activity "in a society where labour power is purchased and sold" - he assumes a contradiction between meaningful, transformative work and commodity labour. This passage also suggests a conception of work which refers more to male than to female employees - few women with both paid and unpaid work have "free" hours to fill, or to experience as a "void". Braverman also seems here to take Marxist categories of analysis in a descriptive way; as though American society consisted of two starkly divided classes - managers in corporate institutions and an oppressed and exploited working class, with the former manufacturing commodities to provide passive entertainment for the "free" time of the latter. Yet the social production of employment, of commodities, and of leisure cannot be treated so simply. Managers also consume commodities, consumers may use products in unintended ways, and the social divisions of age, race, and gender may also structure unpaid work.

Braverman adopts a classical marxian analysis to describe the progressive commodification of domestic goods and services by the 'universal market'. On this account the unpaid domestic labour of women is

undermined by labour saving commodities since, for Braverman, unpaid domestic labour has had an important cohering function.

As the advances of modern household and service industries lighten the family labor, they increase the futility of family life; as they remove the burdens of personal relations, they strip away its affections; as they create an intricate social life, they rob it of every vestige of community and leave in its place the cash nexus. (p.282)

Thus Braverman contrasts the community ties and mutual obligations of unpaid work with the exploitative and dehumanising character of paid work. This sharp contrast has limiting consequences: Firstly, paid work is characterised as nothing but a relation mediated through the cash nexus. The social dimension of employment and the subjective, meaning-giving elements of paid work are thus minimised or denied. Secondly, unpaid work in domestic contexts is characterised as meaningful. The isolation, dehumanisation and non-voluntary aspects of domestic labour are thus minimised or unexplored. Thirdly, a sharp distinction between paid and unpaid work directs attention away from the important interrelationships between these two spheres. Such interrelationships may exist on a number of levels: in terms of women's reproductive labour, in terms of the form and content of women's paid work being determined by their familial obligations; and in terms of the power of domestic consumers to determine, in part, the range of commodity products.

PRODUCTIVE WORK

So far as productive work is concerned , Braverman exhibits a tension between his use of abstract Marxian concepts and the focus of his empirical attention. He devotes a whole section to a discussion of productive and unproductive labour as analytical categories. Yet, in the body of his work, he refers to the notion of productive work in a more descriptive way. He describes the "rapid rise ... in the proportion of those not employed directly in production" (p.239) and he notes the increase in the ratio from 7.7 per cent in 1899 to 21.6 per cent in 1947, with the qualification that it includes "not only engineers, technicians, and the clerical workers associated with production tasks, but all administrative, financial, marketing, and other such employment." (p.240). This suggests that Braverman sees real work as shop floor work, and that clerical and administrative workers are ancillary rather than constitutive of the product.

One reading of Marx suggests that human work embraces a wide variety of paid and unpaid activities. However Braverman's emphasis is on one segment of these activities - employment within capitalist relations of production and, within that, he appears to give productive priority to those workers who have physical contact with the product. Much depends on the notion of production which is employed - this is discussed more fully in the next chapter. For the present, Braverman appears to work within a Marxian notion of value production, yet to place emphasis on physical work around the commodity product.

Braverman appears to flatten the concept of work. Whilst he assumes that capitalist relations of production touch all other areas of human activity he does not acknowledge that capitalism needs the creativity of human labour for value to be generated. Further, Braverman barely acknowledges, either analytically or descriptively, that work is a transformative activity, that people strive to make meaning in their work, even in the most oppressive and alienated circumstances. The view taken here is that capitalism never manages fully to exploit living labour, and that the subjective search for meaning in work is distinct from the economic process of value generation; the production of meaning and of value are analytically separate, yet each are important to a sociological understanding of technologically related work.

PHYSICAL WORK

Braverman's emphasis on the physicality of work is to be found in his focus on manufacturing. Braverman insists that clerical work has a necessary role. Yet despite this insistence he does not see such work as physical. Braverman, like Marx, argues his case with examples largely drawn from the technical production of physical products. There is a compelling simplicity about physical production. Whilst Braverman's discussion embraces manufacturing, clerical, and service sector work, most attention has been given to his analysis of the assembly line, a mode of work organisation which implies a particular form of workplace hierarchy. Firstly, the 'line' suggests an organisation of production designed remotely by

engineers and managers rather than by those who execute the physical labour. Secondly, the assembly line suggests that production is a series of directly physical acts on the emerging product. Thirdly, the assembly line suggests, by its emphasis on the physical product rather than the other aspects of production, a linear organisation of production. This model of production has a visibility in assembly line production, (a visibility which is reproduced in the number of studies in industrial sociology devoted to the car industry, although a relatively small percentage of the British or American work force have ever been employed in assembly line production.) The assembly line has become a powerfully narrowing metaphor for manufacturing work. The model does violence to other kinds of employment. His close focus on the dehumanising aspects of assembly line work is consistent with his stress on Taylorist management methods - in both cases the worker appears cast in a passive and relatively powerless light. Braverman presents the assembly line as a managerial strategy for undermining craft solidarities, yet his stress on the physical imperatives of the assembly line implies not only the passivity of the worker but also suggests the non negotiability of this model of technologically driven work organisation.

Braverman's analysis emphasises the physical dimension of work. His analysis suggests that job designers can provide all the technology and detailed training necessary for production, as if production consisted solely of the motor performance of specified tasks. In this way Braverman emphasises the technical specification of physical production at the expense of

the social collaboration which arguably makes work, even assembly line work, possible. A focus on the physical aspects of production minimises the extent to which conscious living labour is necessary for production to occur. Equally Braverman's emphasis on physical work further serves to underscore the rather mechanical model of production implicit in Labor and Monopoly Capital.

Braverman appears to give political priority to manual work, given his own trade union activities this is not surprising. There are, however, theoretical consequences to this priority. For Braverman the division between mental and manual labour takes on a descriptive rather than an analytical character. The view taken in this thesis is that labour cannot be divided into mental and manual in terms of differing tasks, rather that the analytical distinction between physical work and conceptual work refers more usefully to the elements of productive work. The view taken here (drawn from Marx' own notion of the human labour process, further discussed in chapter four) is that all work has elements of conception and execution, of thoughtfulness and action, and that the politics of production is shaped by this continued necessity for conscious, thoughtful and purposeful human labour.

PURPOSEFUL HUMAN WORK

The deskilling thesis rests on the notion that work was once, and has the potential to become, a fulfilling and transformative human activity. Indeed Braverman begins his argument by evoking Marx's notion of human labour as at once "transforming and transformed". Yet Labor and Monopoly Capital does not develop this notion

of human work. The celebratory conception of the capacities of human labour become lost in the process of charting capitalist exploitation. In consequence, the attributes of the living worker - consciousness, intentionality, purposefulness - are apparently diminished as essential elements in productive work.

Braverman's conception of work is highly circumscribed - his implicit focus is largely on the shopfloor where he sees capitalist relations of production dominating all, through the medium of Taylorist management. Within this account there is little scope to consider the conscious, purposeful, transformative capacity of human labour - the very quality which, in the Marxian view, makes labour valuable to capital. Within this picture of degraded work there is, then, very little scope to consider the extent to which the technology of production requires a purposeful operator.

Braverman's labour process perspective powerfully socialises technology by drawing attention to the ways in which paid work is constrained by management's deployment of technology. What his analysis does not do is to consider the extent to which the power of stored up labour is matched by the creativity of living labour, he does not allow that the technology of production is dependent upon the attributes of human labour power to produce anything at all. Yet the marxian distinction of dead and living labour leads to this conclusion.

Braverman has graphically drawn attention to the harshness of the deskilling tendencies in modern manufacture. In the process, however, he has denied the vitality of human work.

Whilst Braverman has a narrow focus on particular kinds of work and a restricted notion of whose work is significant, yet his analysis does indicate ways in which it is possible to relate the hardware of production to human actors. By his emphasis on the marxian concept of human work, Braverman points us to one way in which technology may become more available to sociological analysis. By emphasising managerial determinants in the development of technology he draws attention to the negotiability of the machinery of production. By an emphasis on work, on the malign effects of deskilling, Braverman directs attention to work organisation as a way to overcome the exclusivities of the technical. However, his focus remains on work organisation rather than on the relations of production of technology. Yet by recourse to marxian categories, Braverman does implicitly suggest a way of giving a social account to objects, an account which does not negate their physicality, but which does not take that physicality as fixed or given.

II BRAVERMAN'S CONCEPT OF TECHNOLOGY

So far as technology is concerned Braverman's thesis rests on three assumptions: that the Taylorist ideal of detailed fragmentation of the labour process is attainable; that the major design impetus of technology is a managerial quest for control of the labour process; and that the effectiveness of production technology is assured, his assumption that technological products will fulfil manufacturers' claims for them.

As several writers have pointed out (see Wood, 1982), managements do not necessarily use Taylorist methods to secure worker discipline, but have instead a number of management styles, cultures, and organisational techniques. Managements are not homogenous groups, they too are comprised of people with conflicting interests and differing skills; management objectives may not be entirely governed by directly economic considerations, neither are they necessarily successful in pursuing their quest for surplus value and profitability.

In Labor and Monopoly Capital Braverman describes how technology has been deployed to deskill and degrade labour.

For the worker, the concept of skill is traditionally bound up with craft mastery - that is to say, the combination of knowledge of materials and processes with the practised manual dexterities required to carry on a specific branch of production. The breakup

of craft skills and the reconstruction of production as a collective or social process have destroyed the traditional concept of skill and opened up only one way for mastery over labor processes to develop: in and through scientific, technical, and engineering knowledge. But the extreme concentration of this knowledge in the hands of management and its closely associated staff organisations have closed this avenue to the working population. What is left to workers is a reinterpreted and woefully inadequate concept of skill: a specific dexterity, a limited and repetitious operation, "speed as skill". (pp.443-444)

This passage is revealing since it lays bare Braverman's nostalgia for an era of craft work which is largely lost. Braverman's notion of craft de-emphasises conceptual skill and emphasises the manual, the physical dimension of work. Braverman here suggests a view of technology which can replace the manual skills of human labour. On this view mastery over labour processes can only develop "in and through scientific, technical and engineering knowledge", as if the only kinds of productive work and the means of "mastery" were those concerned with physical processes. Braverman assumes here an unproblematic application of scientific and technological engineering knowledge. The role of judgement and purpose in work, and the extent to which this cannot be replicated by technology, is not addressed. The thesis of Labor and Monopoly Capital rests on the view that conception and execution, once united, are now divided along Taylorist

lines. Yet where technical knowledge is concerned Braverman here suggests that the relation between theory and practice in production is not seen to be a source of conflict. Braverman assumes that management have the capacity to translate scientific and technological knowledge into effective production, even though they have no direct knowledge of production practice other than through the experience of labour. Whilst there are many examples of the ways in which scientific and engineering knowledge has been applied very successfully to production, this is not always nor necessarily the case. With his focus on and nostalgia for the demise of a craft tradition, Braverman is unable to acknowledge forms of power remaining in the hands of labour. Of equal significance is the certainty with which Braverman sees that control has accrued to "management and its closely associated staff associations". Braverman's thesis, drawing heavily on his own experience of engineering work, is not only that management uses technology in striving to gain control over labour processes, but also that they do so successfully.

The ideal toward which capitalism strives is the domination of dead labor over living labor. In the beginning this ideal is seldom realised, but as capitalism develops machinery and makes use of its every suitable technical peculiarity for its own ends, it brings into being this system of the domination of living by dead labor not just as an allegorical expression, not just as the domination of wealth over poverty, of employer over employed, or of capital over

labor in the sense of financial or power relationships, but as a physical fact. And this is brought about ... by the incessant drive to enlarge and perfect machinery on the one hand, and to diminish the worker on the other. (p.228)

Thus Braverman represents technology as a direct and unmediated expression of capitalist relations of production. Technology is presented as a compliant medium for management power, although the precise means by which current managements successfully transform their needs into technical specification and into working technology are unexplored. Whilst vigorously refuting technological determinism, or the fetishism associated with 'technical needs', 'machine characteristics', and 'the requirements of efficiency' (p.230) Braverman nevertheless appears to put technology on a pedestal, to presume its appropriateness and success in expressing management relations, and its efficacy in replicating ever larger fragments of human labour. Braverman assumes that the efficiency and effectivity of technology offers managers the means of dominate labour. By this assumption Braverman appears to place the technology of production outside the living labour from which it originated. Yet in both a commonsense way, and in terms of a marxian analysis, technology cannot be seen independently of living labour. Technology not only has its genesis in human work, it also needs human labour to deploy it effectively and purposefully.

For Braverman, the appearance of production technology masks a reality of class control in the workplace.

His concept of technology is thus profoundly political. Yet there are curious silences in his analysis, silences which relate not to the politics of (managerial) use but to the politics of (technological) production. Braverman says little about the social relations of production which pertain to the technology of production. His focus is on technology within capitalist relations of production. Yet in detailing the deskilling tendencies of these relations he is actually concerned not with production but with the consumption of technology. His analysis is of the managerial deployment of technology, not with the labour process of its generation. Braverman does not address the question of consumption, nor does he question the way in which management develop technology in their own image.

Whilst Braverman does not explore the ways in which the negotiability of technology favours management but not labour, his account does present technology as a social product. Unlike the more recent writings within the sociology of technology discussed in chapter two, Braverman not only sees machinery as a social product but also is quite specific about the particular social relations which are important to the constitution of machinery, "in relation to human labour".

Braverman makes use of the Marxian concepts of dead and living labour to account for the liberatory and oppressive aspects of machinery. The use of stored up past labour clearly aids production.

Considered only in their physical aspect,
machines are nothing but developed

instruments of production whereby humankind increases the effectiveness of its labor... This past labor, incorporated into instruments of production, imparts its value to the product piecemeal, as it is used up in production - a fact which the capitalist recognises in the depreciation allowance. (p.227)

However, cautions Braverman, this enhancement of present labour by the use of stored up past labour also has its exploitative side.

Now, as a material process, production which makes use of tools, instruments, machinery, buildings, etc. is an ordinary and easily comprehensible activity: living labor making use of its own past stored-up labor to carry on production. As such a purely physical process, its terms are as clear as the relation between the first axes or potter's wheels and the men and women who used them. But within the framework of capitalist social relations, all is reversed. The means of production become the property of the capitalist, and thus past or dead labour takes the form of capital. The purely physical relationship assumes the social form given to it by capitalism and itself begins to be altered. The ideal toward which capitalism strives is the domination of dead labor over living labor. (p.227)

Braverman's use of the marxian concepts of dead and living labour is telling. These provide him with a theoretical means for exploring past and present labour, for exploring the relation between artefacts and the purposes of human work. These twin concepts of dead and living labour offer the opportunity to step away from the technical exclusivities of hardware, to distinguish between stored up (dead) labour and conscious (living) labour, and to explore the relation between these two expressions of human work. Yet curiously Braverman does not develop these concepts through his deskilling thesis, nor have they been acknowledged by subsequent labour process writers.

In his comments on machinery Braverman draws implicitly on another Marxian notion - the centrality which Marx accords to the purposes of human work. By emphasising managements' purposes in the development of machinery Braverman resists notions of technical imperatives and directs attention to the social constituents of workplace machinery. He does not, however, examine the determining role of worker purposes in the use of the technology of production.

Braverman signals the explanatory potential of Marxian concept of labour process for the study of technology, a potential which he himself did not fully pursue. (Later chapters in this thesis develop these marxian concepts of human labour process, dead and living labour, and of production and consumption to develop a sociological account of technology.)

The use of the Marxian concept of labour process is a central strength of Braverman. Another concerns the

style and voice of explanation which Braverman adopted to analyse technological events. Braverman's own biography was rooted in labour history and organised resistance to the oppressiveness of the capitalist mode of production. By presenting the technology of production in terms of this struggle Braverman provided trade unions with an understandable and relevant analysis of technological change. Like Marx (who asked only that readers should be diligent), Braverman presented a thesis that found visible referents in the manufacturing workplace. Braverman's account made the industrial politics of technology accessible without recourse to the complexities of technical knowledge. Braverman provided an analysis which was rigorous but without recourse to lofty academicism.

There are, however, shortcomings to Braverman's approach, especially to his separation of political economy and technical knowledge. His perspective is that of the waged shop floor worker; that perspective provides the engaging narrative thread of the entire book. But the approach does not enable Braverman to recognise or to acknowledge the need to integrate knowledge across divisions of labour, to combine shopfloor knowledge with the more abstract knowledge of workers engaged in the design and development of production technology. Thus the reader is given little help to understand how management intentions are mediated into technological design - as if technological forces of production do not themselves have workplaces, let alone exploitative origins.

Thus, in the process of arming labour with a socialised analysis of the role of machinery in oppressive work

relations, Braverman may also be seen to be objectifying technology as a successful weapon in the armoury of capitalist management.

By presenting technology as a successful expression of management power, labour process writers are unable to explore the vulnerability of production technology. It may seem strange to call attention to the fragility of technological products since everyday life gives evidence of impressive power and accuracy associated with technology, yet, like other products of human labour, technological products have strengths and vulnerabilities. Work-enhancing strengths and vulnerabilities which may derive from a number of sources: from the conditions of technological production; from the contradictions of the commodity form of technology; or from the organisational tensions arising from those workplace accommodations which must be made if particular technologies are to yield up their usefulness.

Braverman's political project, like that of later labour process writers, clearly does not lie in exploring the fragility of dead labour, but in alerting activists to the potential dangers of technological change undertaken by Taylorist managements. To this extent Braverman has a zero sum model of power, in his view power lies in the hands of management and through them, in technology. The view taken here is that this emphasis is analytically and strategically flawed: analytically flawed because of the continuing role of human labour in production. Strategically flawed because the relation between management and technology is more contradictory than Braverman suggests.

Following Braverman labour process writers have largely left the social relations of technological production unexamined, and focused instead on the consequences of technological change in the paid workplace. This approach has served to emphasise the power of technology and to place a corresponding de-emphasis on the limitations necessarily encountered in any attempt to deploy technologies in specific settings.

Labour and Monopoly Capital may be seen to embody two keys ideas: a particularly prescribed view of human work, and a naive optimism on the capacities of the technology of production; the assumption is that technology will meet the control needs of management (and out-perform human work). Labor and Monopoly Capital is locked into a traditional view of management intentions and worker exploitation and impotence. In some respects Braverman displays a highly traditional notion of the economic base of social life, and his limitations stem in part from the rather mechanical aspects of that model. Braverman's marxism gives him the insight to see technology as a political rather than a technical tool, yet his version of marxism traps him, so far as the development of a sociology of technology is concerned, into a limiting notion of work. Braverman's concept of work is limited by an over-emphasis on the economic character of capitalist relations of production; and his concept of technology has a productivist emphasis, an emphasis which, by its focus on technology in productive work, ignores the social relations of its own production - both in the immediate workplace and in the wider social context.

III TRANSCENDING THE LABOUR PROCESS DEBATE: DAVID NOBLE

There are, however, two writers, David Noble and Cynthia Cockburn, who show that it is possible to move beyond these theoretical constraints, they develop a marxian framework and to take a number of social factors into account. Both have demonstrated ways in which labour process analysis may be moved in more culturally sensitive directions. Both are indebted to a labour process perspective yet in different ways their work represents an interesting attempt to take a broader view of the features which constitute technological work.

Both writers focus on paid work in profit seeking companies, take an unexamined definition of the technology of production, and accept the deskilling tendencies outlined by Braverman. Yet both - in dissimilar ways - explore features which go beyond the economic concerns of classical marxism. The work of Noble is discussed below, that of Cockburn in chapter six.

Noble's focus is the technology of production. As an historian he explores the production of one particular technology. His particular focus concerns events surrounding the adoption and development of one form of automatically controlled machine tool. In the process he provides a detailed account of how one machine come to represent the interests and concerns of management.

In several respects Noble shares Braverman's marxian conception of the organisation of production: he recognises the significance of managerial control in

Fordist production; and he places emphasis on the ways in which managerial control is extended through the design and deployment of the technology of production. However, Noble's approach is that of a marxian labour historian, rather than that of a marxian economist. Whilst he embraces some aspects of Braverman's thesis, Noble takes the argument forward in important ways. Most particularly, Noble points to one means of avoiding Braverman's economic analysis whilst, at the same time, recognising the wider cultural context of technological design and deployment.

In Social Choice in Machine Design (1979), a case study which was later given fuller treatment in Forces of Production: A Social History of Industrial Automation (1984), Noble essays, "a case history of the design, deployment and actual use of automatically controlled machine tools". His task is to chart the ways in which workplace conflicts become constitutive features of technology: of the way technology becomes 'frozen' social relations. Noble seeks to go beyond the formalism of marxian political economy. He comments on the lack of historical specificity and concreteness in accounts of the "dialectic between forces of production and social relations" His analysis traces "both the horizontal relations of production (between firms) and the vertical relations of production (between capital and labour)' as well as examining "social choice in the deployment of technology" and "shop-floor realities where the technology is being used".

Noble contains this methodologically ambitious project with an historian's attention to detail and

perspective. He traces historically some of the major social choices which contributed to the popularity of numerically controlled (N/C) machine tool technology and the demise of the more direct record-playback machine tool technology. Using N/C, patterns for tools are recorded digitally and are not dependent on skilled workers to prepare the prototype. The alternative system, record-playback is based on an analogue principle and thus depends on skilled workers to set up the initial patterns. Where N/C is a computerised abstraction of the physical task, the record-playback method retains a more direct link between conception and execution. Noble shows how, despite clear benefits associated with the record-playback method, managerial considerations of labor control took priority over technical benefits - considerations which were given added weight by the allure of 'automation'. Where Braverman's analysis focuses chiefly on Taylorist management techniques as a determinant of technology in the organisation of production, Noble's account embraces a number of constitutive practices: Firstly, he describes an engineering ideology that saw the separation of conception and execution as an index of progress.

N/C was always more than a technology for cutting metals, especially in the eyes of its MIT designers, who know little about metal cutting: it was a symbol of the computer age, of mathematical elegance, of power, order, and predictability, of continuous flow, of remote control, of the automatic factory. (Noble, 1979, p.116)

Secondly, he indicates the importance of state purchasing decisions in particular markets and the consequences of these decisions for the hardware design process.

...the air force created a market for N/C...research and development expenditure in the industry multiplied eight-fold between 1951 and 1957. (Noble,1979,p.113)

Thirdly, Noble points to competition between capitals for state contracts and the significance of militarism in international politics.

Fourthly, he refers to the extent to which managerial problems of labour control produced a readiness to believe technological hype.

There is no question but that management saw in N/C the potential to enhance their authority over production and seized upon it, despite questionable cost-effectiveness. Machine-tool builders and control manufacturers, of course, also promoted their wares along these lines: well attuned to the needs of their customers, they promised an end to traditional managerial problems. (Noble, 1979, p.118)

By suggesting that N/C machines are a product of multi-layered contestation and competition, Noble undermines the assumption that market forces disinterestedly promote the most cost effective product; that state and commercial managements apply rigorous technical

criteria to the selection of technology; that "automated" processes are independent of conscious human labour. At the same time Noble confirms the view that technological means of production are selected and constructed within the context of engineering and management ideology and that, as consumers, both companies and nation states are themselves exploited by technology producers making an appeal to the ideology of automation.

Noble gives us a glimpse of the social complexity of technological constitution as an interplay of state, capital and labour. An interplay which includes the following: the American state, outside the demands of profit maximisation but with unprecedentedly huge consumer power; corporate capital as an eager supplier to the state; individual companies seeking to maximise their advantage by excluding competitors in state markets; capital as management with labour control problems; companies as consumer, prey to the commodity forms produced by other capitals; and labour resistance on the shop floor. Noble's account contextualises machine tool technology by indicating the social complexities of technological production and consumption in manufacturing industry. His historical work testifies to the intricate interrelationships - organisational, institutional, and representational - which characterise real life.

Noble manages to combine two elements: on the one hand he employs a marxian notion of production as stored up labour. On the other hand he gives a detailed account of the historical and contextual elements which shape the product - in this case the numerically controlled

machine tool. Noble thus goes beyond marxian formalism by demonstrating the ways in which patterns of power and cultural values shape the actual process of technological development.

Because of its very concreteness, people tend to confront technology as an irreducible brute fact, a given, a first course, rather than as hardened history, frozen fragments of human and social endeavour. (Forces of Production p.xiii)

CONCLUSION

This chapter has considered Braverman's concept of work and of technology, and the elaboration of labour process to be found in Noble. The focus of each is on paid work, on physical work, and on machinery. The image of the engineering workplace, with all its masculine resonances, looms large in these and in labour process texts generally. Yet that focus has not, itself, been the topic of critical debate. The labour process debate which Braverman inspired chiefly calls attention to the historically divergent ways in which workplace organisation, managerial strategies, and technological change, interrelate. Within industrial sociology generally the notion of labour process has been taken up chiefly to explore this interrelationship. Yet in Labor and Monopoly Capital Braverman does not have this relatively narrow set of concerns, by use of marxian concepts the text directs attention back to notions neglected not only by industrial sociology but also by more general marxian sociology. The next chapter then will return to Marx' notion of labour process to explore the utility of his formulation for a sociology of technology. The broader notion of work, hinted at in Noble's work and elsewhere in this chapter, concerning the cultural constitution of products, will be taken up in both the next chapter and in the discussion of cultural studies in chapter five.

CHAPTER FOUR: TECHNOLOGY AND THE LABOUR PROCESS - AN ELABORATION OF MARX.

Of the many constitutive elements of technology, the focus of this thesis is on work, both paid and unpaid, which is directly related to the constitution of technology. Whilst labour process writers have done much to illuminate aspects of technologically related worker exploitation, their interpretation of Marx has narrowed the terms of debate where technology and work are concerned. This chapter returns to Marx' own concept of labour process to argue that the notion of labour process can have broader, more culturally sensitive application - to work and to the technological products of work - than contemporary labour process literature suggests. Whilst it may be argued that Marx' account, like that of Braverman, displays a tension between the theoretical and the empirical, nevertheless there appear to be grounds for supposing that a re-interpretation of Marx' account has much to offer a sociology of technology. The following discussion is not intended in any way to derive a 'true' or 'correct' reading of Marx, but rather to explore the theoretical elements in his concept of work - as a necessary prelude to a sociological understanding of technology.

There are, I shall argue, features of Marx' concept of labour process which have been minimised in the industrial thrust of labour process writing. Three key aspects of Marx' concept of labour process are considered: the human labour process, the production

and consumption of value, and the relation between past and present labour. These are discussed and developed with particular reference to developing a sociology of technology.

The last chapter presented the view that contemporary labour process writers have focused chiefly on the oppressive and dehumanising work relations in profit seeking companies. This chapter aims to show that Marx' own analysis of labour process - as set out in Capital I - has broader explanatory potential. I have argued that Braverman and other contemporary labour process writers have constructed a relatively passive model of worker, Marx however asserts the centrality and agency of the human worker. Unlike modern labour process writers, Marx analysis has relevance not only for employment but for other contexts of human work. Where Braverman and others focus on particular labour processes for analysis, Marx calls attention to the complex interrelationship between labour processes and between producing and consuming elements within labour processes. Where contemporary labour process writers see technology as hardware, as superior to human labour, and as a deskilling tool of management, Marx analysis of dead and living labour provides for a recognition of the strengths and limitations of both past and present labour. Marx analysis of labour process, then, here forms the basis for a more careful examination of work, and thus of the work of producing and using technology.

There are three strands to the argument in this chapter. Firstly, in an exploration of Marx' concept of human labour power, the uniquely creative character

of human work is discussed. Secondly, Marx' account of the production and consumption of value is considered. Thirdly the discussion turns to Marx' concepts of dead and living labour and their relevance for a sociology of technology.

I THE HUMAN LABOUR PROCESS

In his analysis of labour process in Capital I, Marx makes a clear distinction between the human labour process in general and the particular relations which comprise the capitalist labour process.

The process of production, considered on the one hand as the unity of the labour-process and the process of creating value, is production of commodities; considered on the other hand as the unity of the labour-process and the process of producing surplus-value, it is the capitalist process of production, or capitalist production of commodities. (p.191)

The exploitative dimension of work within capitalist relations of production is central to both Marx and contemporary labour process writers. However, the purpose of this section is to point to an equally important strand in Marx' analysis - the necessarily creative and transformative character of the human labour process. This is a key aspect of Marx' analysis. Marx does not present a view of the worker as a passive adjunct of industrial processes, he retains a notion of work as purposeful, as essentially human. Even while Marx is describing the ways in which capitalist relations of production are subordinating relations he does not lose sight of the unique capacities and character of the human labour process. For Marx, as we shall see, the very strength of capitalism rests upon harnessing the value generating properties of human labour. For Marx the

human labour process is not crushed by capitalist relations of production but necessarily remains as the creative element that allows value to be produced.

For Marx, the human labour process is characterised by an active worker, labouring upon a relatively unyielding physical world. The elements of Marx' concept of the human labour process appear in this famous passage:

We pre-suppose labour in a form that stamps it as exclusively human. A spider conducts operations that resemble those of a weaver, and a bee puts to shame many an architect in the construction of her cells. But what distinguishes the worst architect from the best of bees is this, that the architect raises his structure in imagination before he erects it in reality. At the end of every labour-process, we get a result that already existed in the imagination of the labourer at its commencement. He not only effects a change of form in the material on which he works, but he also realises a purpose of his own that gives the law to his modus operandi, and to which he must subordinate his will. And this subordination is no mere momentary act. Besides the exertion of the bodily organs, the process demands that, during the whole operation, the workman's will be steadily in consonance with his purpose.
(p.174)

Marx then places particular emphasis on two defining aspects of the human labour process: on human purpose and imagination, and on the discipline provided by the material world. These twin characteristics affirm Marx' concept of an active worker, and of the relationship between the worker and an already existing historically constituted environment.

In the Marxian conception, purpose is the cohering force to human work; the purpose of the worker provides a continuous touchstone for productive decisions. The purpose of the worker shapes the detailed process of production. The everyday experience of realising purposes constantly requires the worker, the creator, to refer back to original purposes, to match those against present obstacles or changed circumstances, and to reflect and possibly to revise conception in the light of these.

In keeping with his view of the human labour process, Marx insists that the worker, the creator, the architect must exercise imagination, must have a prior conception of the product of labour. To do this in practice, producers must conceptualise from what they know, presume, or imagine to be the requirements of the consuming context. This productive imagining is central to Marx' concept of use value, which is discussed below.

In Marx' conception of labour process, the essentially human character of the architect/worker lies in the capacity to imagine a subsequent labour process where the product will realise its usefulness. Imagination, disciplined by purpose, are uniquely human traits - and

provide the core to Marx' conception of labour process. When work is informed by purpose it is necessarily directed towards particular and specific conceptions of utility. In this sense purpose and utility reciprocally form the fundamentals of Marx' conception of human work.

Marx asserts the agency of the worker and, at the same time, calls attention to the discipline provided by the material world. He insists that the worker must have a prior conception of the product, a conception which not only gives meaning and purpose to work, but which also has an historical context. For Marx conception is no idealistic imagining, or flight of fancy, since the "structure in imagination" is continuously disciplined by purpose-expressed-through-material. And, for Marx, the material world is invariably a socially mediated phenomenon. Human labour works on material that has been 'filtered through by previous labour' (p.174). When the architect sets to work his conception is composed of elements - tools, materials, techniques - which have been framed by already existing circumstance. The labour process coheres and objectifies expressions of human labour from the past and present, it represents work on embodied, stored up work. Raw materials, instruments of production, and the useful character of the product are, then, all social phenomena, all exist before the architect raises his imaginary structure, all these elements exert a disciplining force on the imagination - creativity becomes embedded in already existing material circumstances. Marx concept of the human labour process emphasises: the transformative character of human work; the ways in which that work is shaped by

purpose, and by the consuming context; and the extent to which the architect in Marx' example provides a bridge between past and future labour processes.

Each of these elements has potential for a sociology of technology. Marx' concept of human labour process has been explored here as a means of developing a concept of work which is neither productivist or economic. By drawing attention to the transformative, purposeful, contextual and transitive aspects of the human labour process, Marx' concept places emphasis on the centrality of conscious human labour in work. Marx' account insists that human creativity is necessary for things to be produced at all, an approach which runs counter to depersonalised notions of "automatic" technology. Marx' concept of human labour process has, at its heart, an essentialism; it expresses a view of human nature. The concept is not confined to paid work, or to directly physical work. Thus the marxian concept of human labour process has the potential to embrace a number of sites, a number of workplaces where technology - in both its material and symbolic forms - is produced and consumed.

II THE PRODUCTION AND CONSUMPTION OF VALUE AND USE VALUE

In Marx' conception of labour process, human work is at once production and consumption; producing products for future use whilst consuming the products of past work. For Marx, production and consumption are not two descriptively different activities, but rather analytical distinctions to be made about human work. In popular usage "production" is tied to activity in enterprises whilst "consumption" is associated with domestic contexts. Marx' analytical concepts of production and consumption emphasise the relational aspects of these twin moments, for Marx production and consumption imply each other. For Marx, production and consumption refer not to goods but to value - work entails using value in the products of past labour and, in the process, creating new products for future labour processes.

The following paragraphs in this section discuss in turn Marx' concepts of value, use value, production, and consumption. These strands together elaborate a Marxian concept of human work which has the potential to be both socially and historically embedded, and which point to the complex interrelations between labour processes. The view put here is that whilst Marx focused on industrial production, his analysis has a greater potential. Marx concept of labour process has the scope to embrace the diversity of human work in and out of employment; and to develop a notion of work which is both production and consumption.

This potential for broad application has particular relevance for the study of technology. As chapters two and three have suggested, the sociological study of technology has focused chiefly on the hardware of production in profit oriented enterprises and, within that, on the productive worker using that hardware. I shall argue that Marx' concepts of value and of production and consumption enable the discussion to go beyond this productivist emphasis and to consider technology within and without the shop floor.

VALUE:

Marx characterises the human labour process, as processual, productive work, the creation of value in an end product. The capitalist process of production is characterised by an emphasis not on value but on surplus value, produced within capitalist relations of production. For Marx, these are not alternative forms of labour process, but differing perspectives on work within capitalist societies. The production of surplus value is necessarily dependent on the production of value. Capitalist relations of production may constitute a particularly exploitative form of labour relation, but - as the following discussion tries to show - that does not invalidate or substitute for the production of value in the human labour process.

If we now compare the two processes of producing value and of creating surplus-value, we see that the latter is nothing but the continuation of the former beyond a definite point. If on the one hand the process be not carried beyond the point,

where the value paid by the capitalist for the labour-power is replaced by an exact equivalent, it is simply a process of producing value; if, on the other hand, it be continued beyond that point, it becomes a process of creating surplus-value.

(p.189-190)

Where the human labour process is concerned with the creation of value, the capitalist labour process is identified with the production of surplus value. To the extent that surplus value expresses the appropriation of value, then the concept of surplus value is specific to capitalist society. Surplus value is then concerned with ownership, of the means of production, of labour power, and of the products of labour.

For Marx the stored up human labour in products is expressed in the concept of value. In Marx' anthropocentric account human labour, value, is embodied in products. Useful products are made, and then consumed in the making of new products, which are themselves consumed in turn in yet more productive work. In work value is transferred, whilst use value is exhausted.

As regards the means of production, what is really consumed is their use-value, and the consumption of this use-value by labour results in the product. There is no consumption of their value, and it would therefore be inaccurate to say that it is reproduced. It is rather preserved... (p.200)

For Marx, work is represented in the embodiment of value in products, and value implies usefulness.

...nothing can have value, without being an object of utility. If the thing is useless, so is the labour contained in it; the labour does not count as labour, and therefore creates no value. (p.48)

Marx distinguishes between three concepts: value, a quantitative expression of embodied human labour; use value, an expression of the potential usefulness of a product; and surplus value, the unpaid and appropriated element of labour power embodied in products. Only this last is specific to capitalist relations of production.

USE VALUE

In outlining what has become known as his labour theory of value, Marx pointed to the productivity of human work as the basic unit of material life. Productive work creates value. Value is, for Marx, the general expression of embodied human labour, whilst use value has a specific character - products are useful in particular contexts, they cannot be generally useful. In several passages Marx defines the concept of use value as the specific, contexted usefulness of products.

On the one hand all labour is, speaking physiologically, an expenditure of human labour-power, and in its character of identical abstract human labour, it creates

and forms the value of commodities. On the other hand, all labour is the expenditure of human labour-power in a special form and with a definite aim, and in this, its character of concrete useful labour, it produces use-values. (p.53)

and

If we...compare the process of producing value with the labour-process, pure and simple, we find that the latter consists of the useful labour, the work, that produces use-values. Here we contemplate the labour as producing a particular article; we view it under its qualitative aspect alone, with regard to its end and aim. (p.190)

The architect works on the socially constituted physical world. Work is disciplined by that already existing social formation. All labour processes entail a productive amalgam of human labour and the products of past labour - raw materials, tools, techniques. Marx gives an analytical emphasis to the transitivity of human labour into products and thus draws attention to the means by which human labour is objectified into products, which become, in turn, elements in subsequent labour processes.

In the labour-process...man's activity, with the help of the instruments of labour, effects an alteration, designed from the commencement, in the material worked upon. The process disappears in the product; the

latter is a use-value, Nature's material adapted by a change of form to the wants of man. Labour has incorporated itself with its subject: the former is materialised, the latter transformed. That which in the labourer appeared as movement, now appears in the product as a fixed quality without motion. The blacksmith forges and the product is a forging. (p.176)

When the architect raises his structure in imagination he not only battles with the historically defined resistances and labour filtered world of physical matter, his creative purpose must also take account of the likely usefulness of the product. In the production of commodities, products for exchange, the architect creates a useful thing, a desirable object for exchange. But the construction of usefulness demands some familiarity with the context of use, thus evaluations of utility can only come from a subsequent labour process. Definition is, for Marx, a contextual matter: Raw materials, instruments of production, and the useful character of the product are all defined by their role within present or future labour processes.

...whether a use-value is to be regarded as raw material, as instrument of labour, or as product, this is determined entirely by its function in the labour-process, by the position it there occupies: as this varies so does its character. (p.178)

Within his concept of labour process, Marx' notion of use value is important to the sociological study of technology: the notion of use value draws attention to

the connectivity of labour, to the necessary relation between the work of production and the purposes of consumption. Unlike contemporary labour process writers, who tend to make a sharp distinction between the production of technology and its deployment by management, Marx connects production and consumption, his concept of labour process points to the centrality of context. For Marx products have no utility (and thus no value) unless they can be realised in a particular context. In subsequent chapters of this thesis specific technologies in particular contexts are discussed, these accounts point to the ways in which the stored up labour in products articulates with the purposes and context of consumption.

Use-value, the intentional embodiment of the potential for usefulness, forms one element in production, an element which is considered more concretely in chapter seven.

PRODUCTION

The concentration, in labour process literature, on work at the point of production appears to have led to a narrowness of view, a failure to distinguish between three dimensions of productive work which appear in Marx: production which is the purposeful end of any labour process; the commodity production of physical artefacts; and the production of surplus value in profit maximising enterprises. Whilst Marx does not conflate these three notions of production in his analysis of labour process, he does give emphasis to the work on raw material and the physicality of products.

In Marx' account of simple labour process, production entails the integration of raw materials and tools by a purposeful human worker who can imagine in advance the outcome of his or her labour. In some respects Marx' account is formal and elemental, in others concrete and specific. Like Braverman, Marx constructs an implied worker in his text, a craft worker handling raw materials - metal, textiles and wood. From these particular contexts Marx draws a formal account which addresses the common elements in human work, most particularly within capitalist relations of production. The descriptive features of actual workplaces, of specific purposes enacted by workers in particular settings, may be illuminated and understood by reference to Marx' analysis, but cannot correspond to the elemental form of labour process as Marx set it out. The world of lived experience is necessarily more complicated than that in several respects. Firstly because the elements of production are themselves historically embedded. Work in a social context necessarily has an integrative function since the three elements - tools, materials, and living labour - are themselves complex, socially embedded, entities. For any particular workplace, 'materials' may embrace a wide range of products of prior labour; tools, too, may include intellectual tools and techniques as well as highly complex forces of production.

Secondly, managerial control is rarely absolute in the social complexity of production. Work takes place within a particular context which is itself composed of other products of past labour. In a typical modern

labour process account, management control both the forces and relations of production, yet Marx' account suggests a greater social complexity to production. Whilst in terms of class analysis, the organisation of commodity production in capitalist societies lies in the hands of the owning class, descriptively, in specific organisations, other features may cloud the picture.

Thirdly, Marx' account of the architect recognises the necessary physical element in all work, and acknowledges the disciplining effect of physical matter on purposeful human labour. The rigidities of the physical world are confronted and harnessed in productive work. However, the elements of work, tools and materials, are themselves products of past work. Filtered through previous labour, they are encountered within particular contexts of meaning and associated power relations. The social arrangements constituting and surrounding these physical products may also have a rigidity, and an historical embeddedness.

Thus products are doubly fixed: by being physical expressions of past work, and by being relatively fixed expressions of past work embedded in social arrangements. Analytically distinct, in practice these rigidities are fused. In clerical work, for example, a broken word processor may remind productive workers that tools have a markedly physical character. At the same time, their attempts to have delayed typing work done by another department may indicate the significant resistances of the social world. Whilst Marx emphasises the physical dimension of productive

work, in specific contexts the rigidities of the physical world are only experienced through their integration with the social.

CONSUMPTION

For Marx, consumption entails the consumption of use value. Within the Marxian account, the consuming dimension of the human labour process relates to the products of past labour, the labour of consumption transfers and augments value from products, harnesses the utility of products to productive purpose. Whilst Marx presents products for consumption as the embodied labour of past work, he also recognises the mystification of this process, the way in which congealed labour is masked by the solidity of the product.

Whenever...a product enters as a means of production into a new labour-process, it thereby loses its character of product, and becomes a mere factor in the process...in the process itself, the fact that they are products of previous labour, is a matter of utter indifference...In the finished product the labour by means of which it has acquired its useful qualities is not palpable, has apparently vanished. (p.178)

Within market economics there has been a tendency to associate consumption with domestic consumption, with the purchasing activities of households. Within Marxist economics, the consumer is bound up with the supposedly 'unproductive' activities of domestic workers. The dichotomy production/consumption is set

alongside the presumed economic separation of workplace/household. Both the market and the marxian notions of assumption are at odds with the analytical concept of consumption to be found in Capital I. There is little analytic reason to associate consumption with domestic relations. Marx' analytical category "consumption" is not to be confused with the market description "consumer". The concept of consumption however, is not developed by Marx, and many of his examples are of primary producing activities, involving cotton, ore, coal, etc. This, in part, has contributed to a view of labour process as a linear sequence of producing and consuming relations, terminating in households. Yet, as Marx' analysis of the human labour process makes clear, consumption takes place within purposeful work, within a labour process disciplined by productive intent - whether this occurs within or without commodity labour relations. For Marx, consumption implies production, of goods, of services, and of labour power. This makes the contemporary focus on consumption as a domestic activity curious, since the consumption of commodities involves not only households, but takes place with equal vitality within public organisations and private companies. Industrial and commercial processes which are typically treated as 'production' necessarily involves a great deal of consumption. And just as production is framed by already existing materials, tools, techniques and definitions of utility, so, too, is consumption structured by historical continuities in workplaces - by traditional methods, organisational patterns, and worker subjectivities.

Marx then firstly offers an analytical distinction between production and consumption that has the potential to relate to a broad range of human work. This is not, however, to suggest a homogeneity to work. In differing contexts the categories of production and consumption make sense in differing ways, the character of production in a factory, for example, differs from that in a hospital or home.

Secondly Marx' concepts of production and consumption offer a view of work that is historically contexted, for Marx work takes shape within the social framing of purpose and utility.

Thirdly Marx' account of production and consumption has particular relevance for a sociology of technology. Previous chapters have argued that industrial sociologists and others have adopted a taken for granted view of technology, a view that assumes an identity between technology and the technology of production. The view has been put that this productivist emphasis denies an exploration of the social processes which construct the category "technology". Marx' more analytical approach to work, to production and consumption, offers a way out of this impasse - his notion of work relates to both paid and unpaid work, thus opening up the possibility of exploring the social constitution of technology through a wider range of producing and consuming activities, activities which constitute technology both materially and symbolically.

The paragraphs above have considered four elements of Marx' concept of human labour process: value was seen

as an expression of purposefully embodied human labour with a necessary relation to use value; and usefulness as defined by the context of consumption. All the historically embedded elements of the labour process were seen to contribute to production - the incorporation of past work - and to consumption - a realisation of embodied past labour.

This rather broad interpretation of marxian concepts has a number of strengths: Firstly the discussion has suggested a concept of labour process that is not necessarily located in paid employment, a concept that is not driven by management intention, not solely by economic relations. The discussion suggests that, even for employees, work is more meaning-full than it has been presented in industrial sociology or labour process literature. Within the terms of this reading of Marx, meaning, subjective involvement, and social complexity enter into even paid work. Even the most oppressive, low status work entails the exercise of human ingenuity; and, since paid work entails the harnessing of human purposes, the management and organisation of production is seen to be infinitely more socially complex than simply concerned with the exploitation of labour.

If, as Marx' analysis suggests, there are human purposes in all work, then this has implications for the deskilling thesis of Braverman and later labour process writers. Marx' analysis implies that human purposes are vital to productive work even when that work has in large part been emptied of skill. (This is not to say that deskilled work is necessarily satisfying, but if production depends in part upon

living labour then the politics of technological change are more contestable. Mathews (1989), writing from a trade union perspective, provides an illuminating account of the terrain on which such contests may be conducted.)

The re-interpretation of Marx offered here stresses the active, transformative and necessarily creative basis of the human labour process. This line of argument may appear to suggest that the concept of class, the exploitative dimension of commodity labour relations, has been entirely lost from the analysis. This is not the case. Braverman presents a view of capitalist exploitation that denies the agency of the worker. The reading of Marx offered here stresses purpose, but does not claim that alienated work, work within capitalist relations of production is satisfying. The exercise of purpose does not deny the domination of class relation. Class, and other powerful social divisions, will re-enter the analysis in the more specific accounts offered in later chapters.

A further consequence of this view of labour process is that the stress on the relational character of work, the interrelation of labour processes, provides some means for moving away from economism and towards a more contextual understanding of human work and the products of work. I have presented the view that the definition of tools, materials, and the usefulness of products, must derive from the specific context of work - and by this means to introduce the possibility for an ethnographic dimension to labour process analysis. The next section takes this elaboration of Marx' closer to

technology in a discussion of the concepts of dead and living labour.

III DEAD AND LIVING LABOUR

Marx' analysis of labour process centres simply on the products of past work (tools and materials) and the unique characteristics of the living labourer. Past and present labour, dead and living labour as Marx characterised it, form for Marx the twin elements of the production of material life.

As I have indicated, Marx' conception of labour process stresses the dynamic, the processual, the connectedness and transitivity between past and present labour. Work can be viewed from the point of view of production or of consumption. For Marx each constituent of the labour process is, in turn, the product of past labour. Thus Marx points to the symbiotic relationship between production and consumption; to the productive links between past and present work; and to the technical, historical and social relationships between diverse groups of workers.

Despite the recent wealth of literature addressing the Marxian conception of labour process, the distinction between past and present labour has been almost entirely neglected. On the marxian account, dead labour is the objectification of past work, the embodiment of past work relations, the re-presentation of labour power. In Marx' account, past labour, dead labour, may be associated with physical production, with tools, machinery, instruments and objects of production. And living labour may be similarly seen as the value-releasing element of the labour process, working purposefully, consciously, on dead labour to

release utility.

A machine which does not serve the purposes of labour, is useless. In addition, it falls a prey to the destructive influence of natural forces. Iron rusts and wood rots. Yarn with which we neither weave nor knit, is cotton wasted. Living labour must seize upon these things and rouse them from their death-sleep, change them from mere possible use-values into real and effective ones. Bathed in the fire of labour, appropriated as part and parcel of labour's organism, and, as it were, made alive for the performance of their functions in the process, they are in truth consumed, but consumed with a purpose, as elementary constituents of new use-values, of new products, ever ready as means of subsistence for individual consumption, or as means of production for some new labour-process. (p.178)

Marx here sets out the distinctive characteristics of dead and living labour: so far as dead labour is concerned, this passage reaffirms Marx' view of the contextual definitions of utility, and of the intransigence of physical matter. So far as living labour is concerned, the passage refers to the re-vitalising capacities of purposeful human labour, the power of living labour to realise use value. Marx also refers here to the disciplining role which human purpose exerts on this realisation of past work.

On the Marxian account dead labour requires living labour to unlock its utility. At the same time living labour is galvanised by productive purpose, and by contextually defined possibilities for product utility. Living labour has the capacity not only to imagine and to set purposes, but to integrate existing materials, tools, and technique to realise purpose. But this can never be a mechanical integration. Living labour necessarily employs creativity and flexibility to meet the resistances of the material world, and the inertness of dead labour. As the commonplace work of daily life confirms, putting dead labour to productive use is never easy; there is always some area of intractability between the rigidities of dead labour and the variable particulars of work in a social context. And where dead labour fails, the variability of living labour has to fill the breach, recover the situation by amending means if not end purposes. The living worker has to find ways around the problem if the work is to be completed, if the passage from conception to execution is to be achieved.

For Marx, past labour in products is specific, potentially useful, and inert. Present labour is variable, animate, purposeful, and above all, necessary for work to proceed at all. Marx analysis of labour process rests on these distinctive properties of past and present labour.

For Marx the distinction between dead and living labour is well defined; yet the implications of that distinction for labour process analysis are barely explored in labour process literature, or even by Marx himself. This is particularly the case where

technology is concerned. The following sections present the view that Marx' distinction between past and present labour makes a significant contribution to the sociological understanding of human work, and that the distinction is particular useful in an exploration of technology.

By an emphasis on human work, in the past and the present, the marxian concepts of dead and living labour do provide some means of uncovering the social character of technological products and processes. The concept of dead labour is discussed below in terms of objectified human labour, the dependency of artefacts, and the embedded limitations of artifacts. The discussion then turns to a consideration of the interrelation of dead and living labour in specific workplaces.

OBJECTIFIED HUMAN LABOUR

Marx gives an account of the means by which things become detached from the past labour of production and from the present labour of use. For Marx, products embody purposeful labour of the past. Once finished, however, products take on an identity separate from that of congealed human labour, they become things in their own right.

A commodity is therefore a mysterious thing, simply because in it the social character of men's labour appears to them as an objective character stamped upon the product of that labour; because the relation of the

producers to the sum total of their own labour is presented to them as a social relation, existing not between themselves, but between the products of their labour.... There it is a definite social relation between men, that assumes, in their eyes, the fantastic form of a relation between things. In order, therefore, to find an analogy, we must have recourse to the mist-enveloped regions of the religious world. In that world the productions of the human brain appear as independent beings endowed with life, and entering into relation both with one another and the human race. So it is in the world of commodities with the products of men's hands. This I call the Fetishism which attaches itself to the products of labour, so soon as they are produced as commodities, and which is therefore inseparable from the production of commodities. (p.77)

In his planned Part Seven to Capital I, which only became available in English in 1976, Marx expresses the tendency to objectify human labour even more forcefully. The mystification of social relations is a constant theme in Capital, in Part Seven Marx describes the progressive commodification of all forms of production, including labour power in general. He asserts that under capitalist relations of production the relations and forces of production all take the form of reified entities.

The objective conditions essential to the realization of labour are alienated from the worker and become manifest as fetishes endowed with a will and a soul of their own. Commodities, in short, appear as the purchasers of persons. The buyer of labour-power is nothing but the personification of objectified labour...(p.1003, Pelican edition, original emphasis)

In paid production the fetishism of technological artefacts is particularly striking. Whilst all commodities have mystified origins, technological artefacts have particularly mystified processes of production, made obscure by two aspects of technology related work: by the sharp divisions of labour associated with technical working practices, and by the hierarchical organisation of those divisions expressed in relations of expertise. The forms of specialisation, of social exclusion, associated with technical workplaces minimises the possibilities for a general understanding of technological products as stored up labour.

THE DEPENDENCY OF ARTIFACTS

Applied to technology, the concepts of dead and living labour run counter to contemporary labour process literature, governmental rhetoric, and popular representation. Labour process writers depict efficient managements deploying a mutable technology further to exploit a passive workforce. Against this view, an emphasis on the rigidity or givenness of products and the creativity of living labour strikes an unfamiliar chord. The notion of vitality of people

and the inertness of things is equally strange in a contemporary climate of 'intelligent systems', 'expert systems' and automatic devices. However, the concepts of dead and living labour provide a timely reminder of the limitations and mutual dependencies of artefacts and human action.

One consequence of the dead/living distinction is that it provides a framework to consider the inertness and dependency of things, particularly of technological artefacts which have strong associations of efficiency and reliability. Marx describes dead labour as inanimate; dead labour is fixed, represents a prescribed and predetermined utility. Dead labour cannot work, but must be put to work by living labour. Only living labour has the variability to adapt, accommodate, and revise purposes to allow for the rigidities of stored up labour. Yet the objectification of products, particularly of technological products, denies this fragility of artifacts. On the contrary, the attractions of 'self-acting' machinery, and of 'automation' rest on a presumption that technological dead labour is independent of a vitalising living labour. There are important distinctions to be made here. Technological products are often complex, embody great amounts of stored up labour, and offer an impressive potential for utility. Such products may imitate tasks previously carried out by human labour. However these attributes of technological products do not support the view that 'automatic' devices are independent of living labour. The complexity of stored up labour - however impressive - cannot be put to use without the purposiveness of living labour. A focus on the complexity, speed, and

power of technological products conceals or negates this necessary value-realising function of human work.

In many contexts, it may appear that technological processes are automatic, that operators have simply to press a button. But such appearances focus on the product and deny the living labour necessary for that action to be effective.

The labour of consumption of technological products is, in part, unrecognised because it is concealed within the high divisions of technical work. For past labour to have value a number of arrangements must be in place. Artefacts become useful not only in the context of purposeful living labour but also from human work which is not normally associated with labour process at all. Even in manufacturing contexts departments such as marketing, administration, finance, maintenance, and transport service the work of technical consumption. Outside wage relations, work on domestic technology is also surrounded by purposeful labour. Beyond this there is the wider swathe of work which, at the level of the symbolic and representational, gives meaning and social existence to the artefact. Notions of 'automation', or the fetishism of technology, devalue or deny the more mediated work of technological consumption. The thing becomes more important than the poorly recognised labour which releases value. It seems as if the artifact itself acts.

THE EMBODIED LIMITATION OF ARTEFACTS

A further aspect of the dead/living labour distinction serves as a reminder of another source of the embodied limitation of artifacts and of technological artifacts. Products embody the circumstances and conditions of past labour, products represent both the intentions of past production and the relations of that work. But intentions and relations are themselves complex and contradictory. In production historically embedded tools, materials, and technique must be reconciled and integrated to satisfy human productive purposes. But production is rarely a smoothly organised transformation and is frequently characterised by the tensions, social divisions, intractabilities and inconsistencies of the working context. Products then are limited because they invariably represent the compromises of past production, compromise that is embodied, fixed, in the product.

Where technological products are concerned, the embodied compromise is often experienced as frustration in use, a frustration whose source is made more obscure by the resonance of efficacy which accompanies technological products. The fixity of dead labour often appears not as a limitation but as the very strength of dead labour - in precision and repeatability. In some contexts, in order to realise the utility of this stored up labour, great changes must be made to existing working practices to accommodate the specificity fixed in the product, particularly the notion of utility associated with the product, part of its social existence, changes which further emphasise the autonomy of things. There are

several interrelated issues here relating to objectification, use value and the context of consumption. Artefacts become objectified, dissociated from the human work of their generation. In consequence the utility of the artefacts becomes associated with the product rather than with the purposes of living labour and the context of consumption. A particular conception of utility becomes part of the social existence of the artefacts. Accommodation, or changes in the context of consumption, is often necessary to realise the usefulness of things, especially of technical products which appear to embody highly specific versions of utility. Such is the legitimising power of technical artefacts, that such accommodation seems to underline the apparent efficacy of things, rather than the embodied limitation of dead labour.

DEAD AND LIVING LABOUR IN CONTEXT

To point to the inertness of things and the historicity of things is to do no more than draw out notions already implicit in Marx' concepts of dead and living labour. Marx' account of labour process stresses the rigidity of things and the variability of living labour. In context, however, these characteristics are not so starkly differentiated and take on more complex interrelations. Marx makes an important distinction between dead and living labour. This is, however, an analytic distinction. In specific contexts the negotiability of technological consumption and the rigidity of social arrangements become more visible.

Technological products represent the embodied compromise of past production. Technological products are not simply the physical expression of productive intent; as David Noble reminds us they are contradictory.

...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. Similarly, for all the deliberate care and preliminary planning that goes into them, technologies rarely fulfil the fantasies of their creators. As people are fallible, so too are their machines, however perfect, complete, and automatic the designs. (Noble, 1984, p.325)

When technological products are introduced into existing workplaces, the (socially constructed) narrow negotiability of their use is necessarily revealed, so too is the difficulty of changing social practices, of shifting the heavy weight of social conservatism embedded in biography, institutional practices, and organisational arrangements.

Things are seen as rigid and given. Whilst technological products have no existence other than in social settings, they, too, are presented as given. The social world, conversely, is assumed from the outset to be interrelated, changing, and changeable.

In context, away from analytic distinctions, the interrelation of past and present labour is more clearly revealed. Technological products of past labour may have a fixed physical form but are far from given; and social arrangements which have no directly physical expression, may be characterised by rigidity rather than plasticity.

Dead labour may take a variety of forms; some forms of dead labour are embraced by the cultural category technology. They may take the form of a highly specified artefact - a moulding machine, say, made to order for a particular manufacturer. But the products of past labour may have a less obvious character than that, other forms of dead labour - a manual, or procedures, or a directory - also structure present labour. And yet more ineffable products of past labour may be a house style, an ethical code, or popular imagery about the proper behaviour for a doctor, say, or a solicitor. Each of these products may also have a material form - may also be confirmed by power and status hierarchies (the Law Society for example). The power of these forms of dead labour, felt in the resistance to change, comes not because dead labour represents a physical embodiment, but because dead labour represents a cultural embodiment. To argue otherwise is to abstract physical objects from their realm of meaning and existence. It has been argued (Hales 1980) that knowledge itself may be seen as a form of dead labour. This raises the further interesting possibility that the category "technology" itself may arguably represent stored up labour from the past.

A previously published article "Microcomputers in Education: Living and Dead labour" forms Appendix I. This provides concrete examples of the general points made in this chapter, with particular reference to the objectification of hardware and the resistances and rigidities of social organisations.

CONCLUSION

Marx' approach rests squarely within the discourse of political economy. His treatment of the technology of paid production stresses the efficiency and economy of effort made possible by the use of machinery. Marx points to the distinctive features of machinery, size and constancy.

Increase in the size of the machine, and in the number of its working tools, calls for a more massive mechanism to drive it; and this mechanism requires, in order to overcome its resistance, a mightier moving power than that of man, apart from the fact that man is a very imperfect instrument for producing uniform continued motion. (p.355)

Uniformity of motion and economy of effort - the very characteristics which the hirer of labour power would seek to achieve in modern industry - were already in the nineteenth century becoming identified with the technology of production. From the employers' point of view the apparent regularity and repeatability of technical products stand in contrast to the unpredictability of human labour. Measured against the capacities of human labour, machinery appeared to be superior.

The whole system of capitalist production is based on the fact that the workman sells his labour-power as a commodity. Division of labour specialises this labour-power, by reducing it to a skill in handling a particular tool. So soon as the handling of this tool becomes the work of a

machine, then, with the use-value, the exchange-value too, of the workman's labour-power vanishes; the workman becomes unsaleable, like paper money thrown out of currency by legal enactment. (pp.405-406).

Whilst Marx here suggests that machinery can only substitute for living labour once that labour has been fragmented, he nevertheless presents a nineteenth century belief in the efficacy of production technology to perform tasks hitherto undertaken by living labour, in the power of machinery to substitute for living labour. There are powerful parallels here between Marx' perception of technological dead labour and the enthusiasm and awe accorded to computer technology in present times. The above passage not only accepts the efficacy of machinery but also pre-supposes that owners of these means of production have access to knowledge and production experience necessary to exploit the power of machinery. The role of labour in the social organisation of production is not acknowledged. Marx presents a curiously unqualified respect for the capacities of production technology, yet, at the same time, insists that living labour is central to the generation and preservation of value. The domination of things may be glimpsed even in Capital.

This chapter has explored the constituents of Marx' account of labour process. Three elements were identified: the human labour process, the production and consumption of value and use value, and the distinction between dead and living labour.

It has been argued that Marx' concept of labour process has explanatory power beyond that developed by recent writers in the labour process debate. Nowhere is this more striking than in his emphasis on specificity, on context and utility. None of the elements of the labour process, neither purposeful activity, nor the object of work, nor the instruments of work have meaning outside the relational character of the labour process. Because of the transitivity of the elements, the notion of labour process can only make sense when applied to specific workplaces. The utility and meaning of cultural artefacts, the locatedness of production and consumption, the direction of purposefulness and intentionality can only be realised within particular workplaces, from specific cultural perspectives. This is a key point in Marx' analysis as it relates to a sociology of technology. Marx stresses the duality of utility and context in the shaping of artefacts. By means of formal analysis Marx stresses the locatedness of the labour process.

Marx's concepts of human labour, of production and consumption, and of dead and living labour offer a theoretical framework to consider technology from a sociological perspective. Ironically Marx has become the basis of an academic and political tradition which, by its focus on structures, neglects the human labour process. Marx himself did not develop or extend the notion of the human labour process into his account of the capitalist labour process, Marx' concern was the analysis of sale and purchase of the commodity labour power as a central relation in the social formation. Marx's theorisation of work not only offers an account of the fluidity and dynamism of value but also provides

the potential for a more situated account of work.

This chapter has attempted to make the case that the Marxian concept of labour process provides useful insights for a sociology of technology. However, it is recognised here that Marx' own writing did not display this potential in any elaborated form.

Marx' concept of labour process, and in particular his concepts of dead and living labour, offer a theoretical means to explore the social generation of artefacts. Marx offers some basis for a sociology of artefacts, yet this thesis is concerned to make a contribution to a sociology of technology. Marx' account of labour process does not extend to the construction of the category "technology". The next chapter moves away from marxian political economy and considers the insights that a culturalist perspective can offer to the concept of work and the construction of the category "technology".

CHAPTER FIVE : CULTURAL STUDIES AND TECHNOLOGY

This thesis began with an assumption that the concepts, practices, and products associated with technology have been largely unexplored in sociological literature. Texts explicitly addressed to the sociology of technology were shown to be theoretically and substantively disparate, indeed the very existence of this recent exploratory literature underlines the largely unresolved character of technology in sociology.

It has been argued here that the strength of contemporary labour process accounts has been to place human work at the centre of a sociological understanding of technology. A focus on the concept of work, it seemed, could provide a way into the social character of technology. However, as we have seen, the limitation of labour process literature has been its narrow definitions of work and of technology. A discussion of Marx's notions of the human labour process, the production and consumption of value, and the characteristics of dead labour as a repository of living labour, suggested a potential for a fuller mode of exploration. Yet the discussion of labour process in chapter four has suggested that, for all its strengths, this approach has an inescapably productivist thrust. In formal terms Marx' account of labour process acknowledges the centrality of consumption and of context, but in elaboration this feature is overshadowed by a focus on paid production. The search for a sociological account of technology has directed our attention to the concept of work - but the concept itself needs some further discussion if it is

to provide an adequate tool for the analysis of technology. This chapter takes another approach to human work, one which concentrates not solely on labour/capital relations in employment but on meaning and context in a wide range of human activity.

The focus of this chapter is cultural studies, that loose association of sociology, history, and literary studies which, during the past twenty years or so, have attempted to counter the economism and productivism of Marxian analysis by a focus on the production and consumption of meaning, of values, and of cultural forms. Whilst there are a number of theoretical sources for cultural studies, the writers discussed here are within a marxian tradition; writers who, broadly, are attempting to recover a more humanistic dimension of marxism.

Cultural studies is not a unified field of social theory and the discussion here can do not more than draw out those elements which appear to have potential for a sociology of technology. However, set against the character of marxian labour process debate there are three broad reasons for turning to cultural studies to make a contribution to the sociology of technology: The first reason for turning to cultural studies is the culturalist commentary on work. This is a scant literature, but does provide a useful counter to the assumptions of labour process industrial sociology. The culturalist stress on meaning, on cultural specificity, and on social divisions moves the focus of analytical attention away from the economic relations of paid production toward the more experiential aspects of work. Secondly a culturalist approach may prove

useful to a sociology of technology in the way in which it takes texts and treats them as symbolic and representational entities. This too holds promise to move away from a notion of technology that is simply concerned with artefacts as physical objects. The third element in cultural studies is the stress on readership, on the dynamics of consumption. This too potentially opens up new areas of enquiry for the consumption of artefacts and for the construction of the category "technology".

This chapter has two aims: to elaborate the concept of work from a culturalist perspective; To explore the concept of technology as a cultural form. The culturalist perspective is far from an homogenous body of theory - in a sense the next pages have to raid culturalism for a concept of work and of technology. A first section begins this process by setting out the major markers of cultural study; a second section considers some specific approaches to work and to technology which have been generated from within the cultural studies perspective; and third section assesses the utility of a cultural studies approach for the sociology of technology.

(Note: There are methodological difficulties associated with a culturalist approach which it will be as well to acknowledge at the outset: This chapter explores the idea of work as a cultural practice. It stands in contrast to the discussion in earlier chapters which focused on technology as a material relation between past present and future work. This contrast raises the question of the relation between material and symbolic products.

One approach could be to regard technology-as-dead-labour and technology-as-representation as two distinct modes of analysis, each addressing the same phenomenon from differing perspectives. The problem with this is the suggestion of technology as a free standing phenomenon, independent of modes of analysis, rather than constituted by them.

A second approach, and the one largely taken here, is to acknowledge the partial and undeveloped character of existing tools of analysis. The attempt to forge a sociology of technology inevitably meets with more general theoretical discontinuities in sociology, for example, the extent to which the marxian and culturalist traditions in sociology address different spheres of social life with differing methodological priorities. So far as a sociology of artefacts is concerned, the marxian account of labour process (and especially of dead labour) appears to offer useful insights in placing physical products in their social context. So far as a more rounded account of work is concerned a culturalist perspective may offer useful approaches. The fusing of these two traditions lies beyond the scope of this thesis. However, there is some attempt, in the concluding chapter to bring the material and culturalist tradition together. The task, although not straightforward, is made less difficult for two reasons: firstly because the thesis focuses on marxian cultural studies writers; secondly because the common and specific focus is on what each tradition can contribute to a sociology of technology.)

I CHARTING CULTURAL STUDIES

Cultural studies is a difficult field of work to specify. Developed as a self-conscious discipline over the last two decades, much early work took its inspiration from three British writers: Richard Hoggart, Raymond Williams, and Edward Thompson.

In his synoptic paper, What is Cultural Studies Anyway?, Richard Johnson rehearses the arguments for the academic codification of cultural studies, and outlines his view of the range of analytic practices which might usefully come under the cultural studies banner. He acknowledges the contribution which the disciplines of sociology, history, and literary study have made to the emerging domain of cultural studies, and sets out three distinct traditions within the broad remit to understand "the production and social organisation of cultural forms" (p.26)

Firstly he identifies a tradition of writers who focus on the production of cultural forms.

This is a particularly wide and heterogeneous set of approaches... with very different political tendencies, from the theoretical knowledges of advertisers, persons involved in public relations for large organisations, many liberal-pluralist theorists of 'public communication' and the larger part of writings on culture within the Marxist and other 'critical' traditions. As between disciplines, it is sociologists or social historians or political economists, or those concerned with the political organisation of

culture, who have most commonly taken this viewpoint. Literary approaches have often stopped short at the biography of authors and their 'age'. (p.25)

Johnson identifies a second perspective as 'text based studies', embracing those writers whose chief concern is to treat cultural products - whatever their form - as 'texts', with the intention "to provide more or less definitive 'readings' of them". (p.31)

Johnson's examples stress the literary/linguistic emphasis of this mode of working.

I am thinking, for example, of the literary analysis of forms of narrative, the identification of different genre, but also of whole families of 'genre' categories, the analysis of syntactical forms, possibilities and transformations in linguistics, the formal analysis of acts and exchanges in speech, the analysis of some elementary forms of 'cultural theory' by philosophers, and the common borrowings, by 'criticism' and cultural studies, from semiology and other structuralisms. (p.31)

Johnson identifies a third set of approaches to the study of cultural forms as those which focus on lived culture, on ethnography. The emphasis here, argues Johnson, is on "how to grasp the more concrete and private moments of culture and circulation". (p.44) The overall project of cultural studies then is to consider the work of production, and of the form and content of cultural products. Cultural studies writers

additionally attempt to chart the ways in which such products are consumed by differing social groups in differing contexts.

In the following discussion I consider Johnson's evaluations of the three approaches to cultural studies and attempt to relate these remarks to the study of technology as a cultural phenomenon.

FROM THE PERSPECTIVE OF PRODUCTION OF CULTURAL FORMS

Here Johnson points to two theoretical limitations of marxian analysis which were discussed in the earlier chapters: the problem of economism and the problem of productivism. He thus reproduces in the cultural sphere arguments and limitations which have long been topics of marxian debates concerning material production. So far as economism is concerned, he argues that the 'cultural' is easily lost.

There is a tendency to neglect what is specific to cultural production in this model. Cultural production is assimilated to the model of capitalist (usually) production in general, without sufficient attention to the dual nature of the circuit of cultural commodities. ...the conditions of production include not merely the material means of production and the capitalist organisation of labour, but a stock of already existing cultural elements drawn from the reservoirs of lived culture from the already public fields of discourse. (p.27)

At first sight Johnson's stress on "the dual nature of the circuit of cultural commodities" appears to offer a useful way of lifting 'technology' out of its heavily physicalist connotations, and to embrace a wider range of socially constitutive practices. However, the notion of duality holds some dangers, suggesting as it does a base/superstructure divide, a separation of material and cultural. The notion of duality here is ambiguous: Johnson may be arguing that products have a dual character; or that there are modes of analysis particular to material and cultural inquiry; or that there is a class of production that is distinctively cultural.

Johnson, like other writers in the cultural studies tradition, is anxious to develop a view of production that does not rest solely on economic relations. However, in the process of widening the scope of enquiry to embrace "cultural elements", he does not clearly resolve the question "what is distinctive about the cultural?"

Conventionally, writers within a cultural studies tradition have by-passed this question by focusing upon the processes and products of media workers, on areas where there appears to be a relatively sharp definition of the product and where there is a close relation of product to the production of meaning. Yet, in principle at least, a cultural or even textural analysis of, say, assembly line technology is not ruled out.

The culturalist insistence on the dual character of products appears to offer some potential for the

sociology of technology. To see production as at once material and symbolic offers a way out of object-focused treatments of technology. This approach suggests not only that technical products have a material and a cultural form, but also that a wider range of workplaces may be seen to contribute to the symbolic power of "technology".

Johnson points to productivism as the second limitation to cultural analyses which focus on the production of cultural forms. He describes this as "the tendency to infer the character of a cultural product and of its social use from the conditions of its production, as though, in cultural matters, production determines all". (p.27)

Johnson's caution against an over emphasis on production raises the question of the extent to which, and the ways in which, conditions of production do structure the product, and whether or not 'cultural' products are to be viewed any differently in this regard. Whilst he recognises that "conditions of origin...exercise a profound influence on the nature of the product", Johnson clearly does not want to give priority to "conditions" in understanding cultural forms.

This points again to the question of whether cultural production is to be viewed any differently from other kinds of production and to the issue of whether a notion of cultural production is useful for the study of technical objects and the category "technology"? Is there, for example, an analytical distinction between producing an artefact and producing a text?

between consumer and reader? Johnson's de-emphasis on production and the consequent stress on interpretation or "reading", suggests new perspectives for the sociology of technology, new perspectives on the consumption of technology, especially the negotiability of consumption. Technical artefacts commonly have narrowly defined use values, they are produced for highly specific purposes. This apparent fixity makes the notion of alternative use difficult to imagine. The culturalist perspective offers a way of setting aside this determinism - by de-emphasising production attention is called to the many, and changing, social processes which give life to a product, processes which draw upon already existing reservoirs of value, meaning and purpose.

EXAMINING THE TEXT

If conditions of production, including the purposes, intentionalities, and context of production, play one part in the constitution of products, of cultural forms, then what additional insights may be gained from an analytic exploration of the product itself? What of the form and content of products? The limitations of this approach appears to be the formal abstraction of the 'text' from its context of production or of consumption. Thus, to remain with the literary metaphor, both author and reader are curiously excluded from analyses of 'signifying practices'. The authoring groups and reading, or consuming, groups do not feature in analyses which thus suggest that texts speak for themselves. The processes, often the contradictory processes of production and of consumption, or meaning making, are excluded from

textural analyses. Johnson points however to a key strength of textural analysis - the ways in which texts construct a preferred reading.

The key insight....is that narratives or images always imply or construct a position or positions from which they are to be read or viewed. Although 'position' remains problematic (is it a set of cultural competencies or, as the term implies, some necessary 'subjection' to the text?), the insight is dazzling, especially when applied to visual images and to film. We can now perceive the work which cameras do from a new aspect, not presenting an object merely, but putting us in place before it. If we add to this, the argument that certain kinds of texts ('realism') naturalises the means by which positioning is achieved, we have a dual insight of great force. (p.40)

Such insights may be available for narrative and images, for cultural forms with highly prescribed identities. Where more diffuse forms of cultural production are concerned, 'positioning the subject' may present a more difficult yet intriguing task. To what extent, for example, can computer technology be considered in this light? Would it be possible to explore a personal computer in terms of the form of product design - the shape, colour, mood of physical design, marketing 'pitch' and procedure for use? Would it be possible to divine an inscribed view of the user? To what extent would that parallel a 'positioning of the subject' in Johnson's sense? This raises the further question of how far the literary

metaphor of 'text' may be stretched. And where technical products are concerned, whose "texts" may be taken into account in considering their constitution? Appendix IV charts some of the meanings which were closely identified with 'New Technology' in popular and sociological commentary during the period 1978-1982. The similarity of these representations and their reproduction in a variety of journals, does provide some support for the view that technology (in this particular case 'new technology') in part takes its shape from practices outside science and engineering workplaces, in this case editorial offices and universities. The great methodological difficulty is that of deciding which representational instances should be taken into account; and how may they be evaluated for their definitional significance? Johnson presents the view that it is possible to define texts beyond the coherence offered by the work of a single author, or a series, or a genre.

It is possible...to take 'issues' or periods as the main criterion. Though restricted by their choice of rather 'masculine' genre and media, Policing the Crisis and Unpopular Education are studies of this kind. They hinge around a basically historical definition, examining aspects of the rise of the new right mainly from the early 1970s. The logic of this approach has been extended in recent CCCS media-based studies: a study of a wide range of media representations of the Campaign for Nuclear Disarmament in October 1981 and a study of the media in a 'post-Falklands' holiday period, from Christmas 1982 to New Year 1983. (p.35)

This notion of text still appears to cling to public, clearly circumscribed media products. This focus has two limitations: firstly, Johnson appears to propose the combination of products into a package of meaning ripe for cultural analysis. But it is difficult to recognise the social coherence of that package. To take his example of post Falklands media, a range of techniques and topics, producers and producing contexts, and a similar diversity of readers and reading contexts would participate in this representational package. It is not at all clear, sociologically at least, what social entity is under examination. This lack of object of knowledge is especially acute since the only consumers of the whole output are the cultural studies researchers themselves. Whilst it may be illuminating to uncover the ways in which particular layers of meaning are constructed, we cannot simply read off from this the meaning making experiences of particular groups of media consumers.

Johnson's examples from the Birmingham Centre focus largely on media products. The second limitation of his approach is that it flirts with the danger of seeing cultural studies simply as media studies. Clearly media products are significant and influential conveyors of meaning - but other products of human work also have associations of meaning and value, also have contexts of production, and also are designed for and defined by particular consuming groups. Films, television programmes, and advertising products remain close to the notion of text, yet by focusing too closely on media products, other equally important spheres of human production are overlooked. This is especially important if cultural studies is to offer

analytic insight to the sociological study of technology.

Cultural analyses of text are not easily transferable to the study of technology. Technological products and processes do not appear to have the distinct parameters of film, literature, or other 'texts'. (Whether even these media products have an analytical distinctiveness is, I believe, open to question.) Technological products and processes pose particular difficulties for the analysis of content and form since, unlike literary and visual studies, technical knowledge does not have a well developed critically analytic tradition. To see technology as sign, to regard particular technological products as 'texts' is then to rely on historical, literary, and aesthetic modes of analysis - with the danger that the characteristics of the technical are not seriously addressed. To what extent is it at all possible to see "technology" as a cultural product - without altogether evaporating the physical existence of technological products and the materiality of technological processes?.

It has been argued in this thesis that a major problem for a sociology of technology is the tendency to equate technology with artefacts. Treating plays, films, books as text offers a way of making those artefacts available for social theory. The culturalist tradition does not concern itself with the materiality or the political economy of production. It is concerned to explore symbolic modes of production and consumption and potentially offers a way of stepping away from an objectivist emphasis and seeing "technology" as the

product of a broader and different mode of circulation.

FROM THE PERSPECTIVE OF CONSUMPTION

Johnson argues against analyses which claim to uncover the production of subjects "without additional and different forms of inquiry" (p.40)

...to slip from 'reader in the text' to 'reader in society' is to slide from the most abstract moment (the analysis of forms) to the most concrete object (actual readers, as they are constituted, socially, historically, culturally). (p.41)

The third set of approaches to cultural studies, ethnography, does try to take actual readers into account, to get closer to the experiential whole. There are, of course, significant methodological difficulties in ethnography, in particular difficulties concerned with the influence of social divisions in knowledge producing relations. Johnson reminds us that the relations between cultural researchers and the groups under examination are often characterised by inequality.

Since fundamental social relations have not been transformed, social inquiry tends constantly to return to its old anchorages, pathologising subordinated cultures, normalising the dominant modes, helping at best to build academic reputations without proportionate returns to those who are represented. (p.46)

This passage hints at some of the difficulties of doing cultural research. Eager to move beyond a dehumanising and formalist mode of analysis the culturalist stress is on interpretation, on the interpretive activities of specific social groups. Yet the concern to recognise and explore social divisions produces a culturalist tendency to research disadvantaged groups, precisely those groups where academic appropriation is likely to be a problem. (If, for example, Paul Willis' concern was simply to address theoretic formalism he could have charted the culture of undergraduates rather than working class youth.)

Academic appropriation is one danger, Johnson identifies an entirely opposite danger: to take the "way of life" of a particular group solely on the grounds of its internal coherence.

..the creativity of private forms is stressed, the continuous cultural productivity of everyday life, but not its dependence on the materials and modes of public production. Methodologically, the virtues of abstraction are eschewed so that the separate (or separable) elements of lived cultures are not unravelled, and their real complexity (rather than their essential unity) is not recognised. (p.47)

Johnson argues that the best ethnography uses "abstraction and formal description to identify key elements in a lived cultural ensemble...viewed alongside a reconstruction of the social position of the users.(p.47) By this means the "intersection of

public and private forms (p.48) may be studied. This is clearly an ambitious theoretical and methodological project, resting, as it does, on the identification of significant and coherent "elements of mass culture", a correspondingly precise identification of particular social groups of consumers, and a methodology to explore the meaning making processes at work within the groups. And where technical workplaces are concerned it is particularly difficult to maintain a balance between cultural coherence and theoretical abstraction since the authority of technical expertise and the generalising character of technical knowledge resist transformation into 'lived experience'.

II CULTURAL STUDIES, TECHNOLOGY AND WORK

Thus Johnson describes three approaches to the study of culture, each approach emphasising a particular moment in the circulation of products. Despite the considerable methodological difficulties, it is sociologically intriguing to consider how to explore the production, formation and consumption of technology as a cultural form. Despite the theoretical incompleteness of culturalist approaches, it is tempting to consider the ways in which technical artefacts and practices have symbolic force and, conversely, the ways in which apparently non-technical work contributes to the cultural form, the category "technology".

Cultural studies embrace a range of theoretical perspectives and methodologies, whose unifying character turns upon an attention to the production and consumption of cultural forms, values and meanings - rather than upon the economic aspects of the production and consumption of commodities. "Cultural forms" are, however, slippery concepts to employ; they will need some refinement. The next section briefly considers texts from within the cultural studies perspective. The purpose of this part of the discussion is to explore the extent to which a cultural studies approach to work and to technology can add analytic insights different from the Marxian concepts of labour process identified in the last chapter. The culturalist tradition is not an obvious place to seek insightful commentary on human work. The focus of cultural studies has been almost exclusively outside wage relations, and addressed to areas of personal consumption and sub-

cultural production of meaning. However, simply because cultural studies writers have not addressed more traditional forms of work does not exclude work, even technical work, from culturalist analysis.

The argument proceeds as follows: A first section explores the work of Paul Willis to develop a cultural studies approach to work. A second section considers the account of work to be found in another culturalist writer, Janice Winship. A third section focuses not on work but on technology, and discusses an approach with attempts to set the material in a cultural context - to be found in one aspect of the work of Raymond Williams. A fourth section discusses another culturalist approach to technology, the combination of artefact and text to be found in Morley and Silverstone.

A CULTURAL STUDIES APPROACH TO WORK - PAUL WILLIS

This thesis has presented the view that the concept of human work - both past and present - provides a basis for the sociological study of technological practices. In Learning to Labour: How working class kids get working class jobs Paul Willis provides an account of work in cultural terms. With a focus on consciousness and cultural transformations he gives an ethnographic account of an informal group of working class boys - the lads - during their transition from school to work. Willis explores the contradictory cultural forms within which unskilled labour is prepared for work in a capitalist society. He suggests there is a direct relation between the main features of working class

culture - as it is expressed in shop floor culture - and school counter culture.

Of the many facets of subculture touched upon in Willis' study, his approach to the concept of work is of major interest here. There are, however, three different notions of work in Learning to Labour:

Firstly Willis' ethnography captures the perceptions and attitudes to employment held by the lads. Here Willis graphically presents the lads' reading of the undifferentiated meaninglessness of the employment available to them. At the same time he asserts the lads eagerness to enter the adult and masculine world of manual labour. Rejecting a simple "socialisation" account of how working class boys become working class manual labourers, Willis stresses the cultural element of choosing involved, the positive embracing of dead-end jobs and the active rejection of middle class careers. Willis argues that what is involved in understanding this choosing is a view of the cultural which is "at least in part... the product of collective human praxis" (p.4) In their disaffected adaptation to school, and their seemingly perverse but stereotypical job choice, the lads act out roles apparently inscribed for them in ideology.

The second view of work in Learning to Labour relates more clearly to this thesis. Willis provides a detailed account of the work undertaken by the lads in their production and maintenance of school counter culture. It is this worked-on aspect of the cultural which enables the lads subjectively to experience their objectively subordinate job choices as superior to

those which send the conformists after "jobs with a future". Willis argues that the culture of these non-conformist lads carries with it a mass of contradictory forces which both illuminate and suppress political potential. He shows how the culture of the lads' group contains glimpses of political resistance and transformative activity and, at the same time, that same culture serves as a vehicle to shape, channel, and induct the lads into the working life of the disaffected unskilled working class male. Willis argues that it is the active production of a school resistant sub-culture itself which acts back on the lads to duct them into de-humanising working class jobs.

Through a wealth of ethnographic detail Willis charts the culture of disaffection - the lads' construction and reproduction of working class masculinity, and of the norm of non-conformity to authority - expressed through the institution of school. But the lads work not only on actively opposing the individualism of academic success in favour of the class cultural solidarities of collective academic failure, their work also intersects with gender. In actively rejecting the femininity of mental labour in favour of the masculinity of manual labour, the lads not only invert dominant evaluations of work, but also "choose" their subordinate role - and ensure the successful reproduction of the social order. Willis thus celebrates the vibrancy, dynamism and potential for resistance in the lads' culture. Whilst Willis presents the lads' sub-culture as a relatively detached and coherent entity, he acknowledges the ways in which a more general and powerful ideology acts from outside

their culture to contain and shape the lads' view of the world.

The third view of work which the study contains relates to Willis' own view of commodity labour in both its abstract and concrete forms. Acknowledging the limitations of ethnography, Willis attempts to graft a Marxian account of labour process on to what he sees as the penetrations and closures of the lads' sub-cultural orientation to school and employment. The lads do not differentiate between differing kinds of masculine working class labour - in this respect, Willis argues, they have an accurate perception of the increasing standardisation of work. He also presents their resistance to authority as, at some level, a recognition of the specific character of labour power as a commodity, and its unique wealth-producing capacity as a variable factor of production. Willis further argues that the non-conformist rejection of aspiration - both at school and in employment - relates to their accurate sense of the futility of individualist effort within capitalist relations of production.

The inner logic of capitalism is that all concrete forms of labour are standardised in that they all contain the potential for the exploitation of abstract labour - the unique property all labour power shares of producing more than it costs when purchased as a commodity. (p.133)

Willis then argues that there is an objective material basis to the lads' collective subjective feelings about work and gender. He argues that the lads have

"penetrated" the official dominant ideology of jobs and choices and understand that "real conditions" of their class situation. The limitations to this penetration are seen to be based in the ideology and practice of patriarchy. Willis argues that the lads reject individualism and embrace a form of patriarchal collectivism to be found in manual work.

It may well be that Willis takes an over optimistic reading of the degree of resistance or transformative potential of the lads' sub-culture. Perhaps his analysis does go further than the ethnography warrants. What is clear from his account is the seriousness and complexity of the lads' efforts to produce and reproduce a corporate view of school which is carried over into work.

Willis' account enables the lads' experience of school to be seen as a form of work - the work of producing a culture, work which is neither recognised nor paid as work.

What, then, has Learning to Labour to offer to a sociological account of work and thus of technology? Firstly, Willis provides strong evidence of a mode of work - the production and maintenance of a school counter culture - which is active, meaningful, purposive, and largely outside wage relations. Whilst the school culture clearly takes its form from employment, the lads' cultural labour processes are unpaid. Their reward systems are elsewhere, are to be found in the strong associations of masculinity with manual work. Via their participation in patriarchy the lads are ducted into the service of capital. Thus

Willis points to a specific interrelationship between the cultural forms of sexuality and economic modes of production.

Secondly Willis provides a picture of objectively meaningless work at school and in employment, which is nevertheless imbued with subjective meaning by the forms of resistance adopted towards it. In this respect Willis' account moves close to the marxian concept of human labour process, where the intentionality and purposes of the worker are seen as central. Where Marx' notion of production refers to useful artefacts, Willis' lads work to produce the culture form of resistance.

Thirdly, Willis presents an ethnographic perspective on work. Concerned only with present labour, his study provides a model for considering the processes of work from a class-subjective perspective. He suggests a way of dealing with class that is not tied up with managerial intention - but a notion of class as the production of the subjective. He provides a concept of labour process that is an inversion of those that stress fragmentation and deskilling. In contrast to labour process studies which describe specialisation, fragmentation, and deskilling in terms of management intention, Willis provides a far more located and textured account of the subjectivities and meanings from the perspective of those who are managed. (His account of the dynamism of the disaffected student also provides, inter alia, a convincing reason of why managers should want to impose Taylorist methods of control - an explanation which more passive conceptions of the worker are unable to provide.)

Willis, then, presents a view of human work which is shaped by class and gender, by the economic and sub-cultural, by forms of domination and resistance to it. Learning to Labour represents perhaps a flawed but nonetheless ambitious attempt to bring together a number of sociological strands in the understanding of school/work articulations as they relate to working class males. Willis attempts to work at both micro and macro levels; to identify cultural particularity and, at the same time, to engage in broad social theorising. His work suggests the theoretical difficulties of combining the economic and the cultural in an analysis of work. Learning to Labour especially offers an insight into the detailed ethnography, the specificity necessary to get a purchase on the articulations between the economic and the cultural.

A SECOND CULTURAL STUDIES APPROACH TO WORK - JANICE WINSHIP

Janice Winship provides a rather different approach to the notion of work. In her paper Woman Becomes an Individual: Femininity and Consumption in Women's Magazines 1954-69 from the Centre of Contemporary Cultural Studies, she explores the work of consumption entailed in the construction and maintenance of femininity. Her specific focus is the ideological representation of consumption to be found in women's magazines. Winship's account of the work of consumption in the private sphere implicitly resists any notion of the consumer as a rational agent meeting objective need, and posits instead a notion of consumption related to the production of identity, a

notion that centres on gender and subjectivity.

Like Willis, Winship uncovers the contradictory forces at work in cultural practice.

The dress and appearance through which we are "offered the free and glorious expression of ourselves" become the metaphor and symbolization of that "freedom" but crucially its "illusory" purchase. The ideological construction of 'individuality' for women through consumption and the work of femininity was, at one and the same time a move towards independence from men and, in its display in an ultimately feminine mould a repetition of traditional dependence on, and subordination to, men. (pp.1-2)

Where Willis explored the ways in which masculinity structured the transition from school to work for young males, Winship focuses on the ways in which representations of consumption structure femininity.

From the representations in women's magazines I want to argue that the articulation of patriarchal and capitalist relations, through women's involvement in the process of consumption (and in paid work) has ideologically constructed them as 'individuals'. (p.10)

Using the magazines as an historical resource (rather than as 'text'), Winship details the activities of consuming as they are represented in women's magazines. "Homemaking" thus requires knowledge of particular commodities, of how to arrange colours and furniture in

a room, and how to go about shopping in an efficient way. The work of beauty is presented as personal, creative, and fun - with an emphasis however on diligence and effort. The work of becoming an employee, with appropriate clothes and dispositions, of consumption for paid employment involves yet another set of activities.

Winship's achievement is to show how the work of consumption relates to both the cultural production of femininity and to the economic sphere. Using Castells she argues that "at the economic level of the production process the practice of consumption reproduces labour power; at the political level consumption is an expression of class relations within distribution; and at the ideological level it reproduces social relations as far as the mode of production as a whole is concerned". (pp.8-9)

Winship elaborates this analysis in terms of gender, and most particularly the constitution of 'woman as individual'.

...consumption [ie purchasing] is firstly, so frequent that the repetition of 'individual' choices is endless (for men as well), and appears as 'choice' unlike work which more often seems like compulsion; but secondly its products are so visible, that for women who have also been judged by their looks - even if it is the 'looks' of their house - consumption grants them a market access to the construction of an 'individual appearance', but indeed a feminine appearance which everybody can recognise. Consumption is

therefore the superstructural terrain par excellence for the construction of an ideology of individuality in relation to women. (p.11 original emphasis)

Winship describes how magazine images, in both advertising and editorial, confirm the autonomy of the consumer/woman (as housewife, as working mother, as young woman) whilst at the same time confirming the restrictions of femininity. Winship's paper thus describes how the structures of the commodity market and the structure of women's subjectivity interrelate - through the mediation of consuming work.

Her work offers three strengths: With Willis, Winship offers a version of work which is not rewarded in cash terms but is nevertheless powerfully articulated with capitalist relations of production.

Like Marx, Winship stresses the processual, the interrelatedness of work. Like other culturalist writers, her account of consumption is at once an account of production. Her work represents an attempt to show, in relatively concrete terms, how the twin spheres of circulation interrelate. Winship presents consumption not only as work, but as cultural work. In this she suggests the profound interrelationships between consumption of image and of goods and services. She does not separate the commodity or the physical out of the circulation of cultural products. Thus Winship's paper suggests a significant broadening of the notion of work, of living labour.

Taken together Willis and Winship suggest ways in which to explore the cultural dimensions of human work. With an emphasis on purposes, intentionality and context, a cultural studies approach to work challenges more traditional notions of work, notions which associate work with labour and with wages. It appears to be a characteristic of British industrial relations culture that work is associated with labour, to characterise work as dehumanising because it is paid (an association lightened only by a very class specific relation between diligence and virtue). Against this view Willis and Winship re-insert a vitality and dynamism into the concept of work. In addition, both Willis and Winship give powerfully gendered accounts of work. A culturalist account of work can direct attention to social divisions, to the relation between economic and cultural modes of analysis.

Cultural studies have made a significant contribution to the exploration of the production and consumption of meanings and values - especially as these are expressed in popular representation. What culturalist approaches in general do not do is to consider the symbolic dimension of paid work. In fleeing from productivism they have made a double shift - in both mode of analysis and in object of knowledge. In consequence there appears to be little culturalist account of productive work - as if the economic was a particular set of activities rather than a mode of analysis. Culturalist accounts, then, provide insights on the circulation of meanings, including the meanings which attach to work but mostly the focus is on work of a directly representational kind. Willis and Winship are valuable exceptions here.

Whilst culturalist accounts outlined here attempt to relate the cultural to the economic by reference to capitalist relations of production, there have been few analyses which link the physical products of human labour with their associated meanings and purposes. In stressing the representational dimension of work, cultural studies writers have not in general turned their analytic gaze on products which are not text of some kind, largely they have not extended the notion of readership and interpretation to the artefacts of everyday life, still less to technical artefacts.

There are, however, some attempts to redress this omission: the next section discusses one early yet thoughtful attempt to subject a technology to a culturalist analysis, and one recent attempt to bring both a material and a culturalist perspective to bear on domestic communication technologies.

A CULTURAL STUDIES APPROACH TO TECHNOLOGY - RAYMOND WILLIAMS

In his brief study Television: Technology and Cultural Form Raymond Williams concerns are two-fold: to explore contemporary developments in television, and to present a view of technology which does not divorce technical from social events. Writing in the early 1970s Williams conducts his exploration in the following terms: initially, with an emphasis on monopoly capitalism, he charts the owners and institutions of television broadcasting. This is accompanied by a discussion of the variety of ways in which television programmes build upon existing cultural forms, building, for example, on previous modes of discussion,

drama, and education. Williams considers the ways in which television articulates with other social processes and explores likely developments in terms of technical possibility tied to commercial profitability.

Williams's account provided an impressive departure from, and critical comment upon, the sociological debate about the "effects" of television - on violence, say, or on family life, a debate that continues today in similarly causal terms.

However, William's indicative analysis of television is not the focus of concern here, for what Technology and Cultural Form offers is also a way of conceptualising technology that is based on class relations but whose scope goes beyond that of paid production. Technology and Cultural Form covers not only the form of television but also its content. Form is considered in both economic and cultural terms, whilst content includes an analysis of individual programmes, as well as the overall flow of programmes on a particular day. Although brief, Williams approach to technology has, then, a number of strands - here presented in terms of the production of television, television as text, and the consumption of television.

THE PRODUCTION OF TELEVISION

Williams' stress is on the economic and cultural production of broadcasting. He is not here concerned to give a more detailed account of how broad class-based movements come to be represented in the work of producing programmes or in the scientific and technological work of producing technical hardware for broadcasting. In Technology and Cultural Form the

production of television is seen in emphatically social terms. Williams resists any notion of technological determinism, or objectification of technology, and stresses instead the human intentionality of production and the centrality of class relations.

Williams explicitly rejects technologically determinist accounts in both their hard and more mediated forms, but acknowledges their pervasiveness.

To change these emphases would require prolonged and co-operative intellectual effort. But in the particular case of television it may be possible to outline a different kind of interpretation, which would allow us to see not only its history but also its uses in a more radical way. Such an interpretation would differ from technological determinism in that it would restore intention to the process of research and development. The technology would be seen, that is to say, as being looked for and developed with certain purposes and practices already in mind. (p.14)

Williams account echoes that of Marx in several respects. Like Marx he is at pains to acknowledge the centrality of the purposes of production, of the intentionality of technological production.

This element of intention is fundamental, but it is not exclusive. Original intention corresponds with the known or desired practices of a particular social group, and the pace and scale of development will be radically affected by that groups's specific intentions and its relative

strength. Yet at many subsequent stages other social groups, sometimes with other intentions or at least with different scales of priority, will adopt and develop the technology, often with different purposes and effects. (p.129)

Williams here confirms the de-emphasis on production, or authorship, which is a hall-mark of the culturalist approach. Implicit in his argument is not only a denial of authorial priority but also a suggestion that technical artefacts are available for differing readings, or, put in marxian terms, that use values are not inscribed in products, even when they are technical products.

Williams also follows Marx in emphasising the class-related, processual character of technological development. Despite a pervasive objectification of technology in sociological and communications literature, Williams presents a view of the social dynamics entailed.

How the technology develops from now on is then not only a matter of some autonomous process directed by remote engineers. It is a matter of social and cultural definition, according to the ends sought. From a range of existing developments and possibilities, variable priorities and variable institutions are now clearly on the agenda. Yet this does not mean that the issue is undetermined; the limits and pressures are real and powerful. Most technical development is in the hands of corporations which express the contemporary interlock of military,

political and commercial intentions. Most policy development is in the bureaucracies of a few powerful states. All that has been established so far is that neither the theory nor the practice of television as we know it is a necessary or a predicting cause. Current orthodox theory and practice are, on the contrary, effects. Thus whether the theory and the practice can be changed will depend not on the fixed properties of the medium nor on the necessary character of its institutions, but on a continually renewable social action and struggle. (p.134)

Williams here presents a radical theoretical and methodological proposal for the investigation of technology, in this case television, a proposal which sadly has never been fully implemented. In his review of television as a cultural form, Williams is concerned with class-related social action in general rather than with the particularity of human work. He does not address scientific and technological work directly but focuses instead on the contested character of subsequent outcomes.

...the cable system is indeed no more than a technology, and that every argument about it depends on its highly variable institutions and on the consequently variable links between cable distribution and other forms of service and production. All that needs to be re-emphasised now is that in its most common forms, in the companies which have the finance and the technology available, cable television is an extreme form of the earliest definitions of

broadcasting as simple transmission. Its extensive development, by the criteria of these companies, would gravely damage television production. Yet we are already able to see, from some publicly financed local experiments, that cable technology could alter the whole social and cultural process of televised communications. (p.142)

Williams dismissive "no more than a technology" appears to suggest that he does not see the cultural being constituted in technological workplaces, but rather in the institutional corridors of ownership and control. Williams eloquently outlines the class contested character of the deployment of cable technology.

These are the contemporary tools of the long revolution towards an educated and participatory democracy, and of the recovery of effective communication in complex urban and industrial societies. But they are also the tools of what would be, in context, a short and successful counter-revolution, in which, under the cover of talk about choice and competition, a few par-national corporations, with their attendant states and agencies, could reach further into our lives, at every level from news to psycho-drama, until individual and collective response to many different kinds of experience and problem became almost limited to choice between their programmed possibilities. (p.151)

With remarkable insight Williams thus draws attention to the cultural power of television, especially of

cable technology. Williams here recognises the cultural significance which television was to acquire and its role in the circulation of meanings, imagery and understandings. Many later writers have warned of the anti-democratic and intellectual narrowing consequent upon corporate ownership of press and broadcasting. Unlike Williams, few, if any, have linked those comments to a sociological account of technology.

TELEVISION AS TEXT

Technology and Cultural Form is a revealing title; Williams discusses television in terms of the class issues of ownership and control and he also considers the continuity and changes in television as a cultural form. Whilst both the economic and cultural aspects of Williams' analysis are centrally related to class, the treatments remain relatively distinct and separate. His analysis of technology is not integrated with his account of cultural form. Technology and Cultural Form does embrace the economic determinants of programming, the ways in which, for example, sponsorship influences the televising of sport, but there is no attempt to relate, say, emerging forms of televisual drama to modes of ownership and control. Williams retains a sense of economic determination but allows for the development of new cultural forms which may lead to unanticipated outcomes.

This duality, which combines traditional Marxian economics with an almost literary mode of analysis of new cultural developments, characterises Williams overall approach. Thus his reference to the commercialism of television sport, the association of

tobacco companies, and governmental controls on cigarette advertisements is immediately followed by more celebratory commentary.

Yet we should also recognise that regular televising of a wide range of sports has created new kinds of interest, not only among spectators but among potential participants.

...with its detailed close-ups and its variety of perspectives, has given us a new excitement and immediacy in watching physical action, and even a new visual experience of a distinct kind. (p.68)

In an attempt to display the sequencing, positioning of topics, and silences in television news, Williams gives detailed examples of actual broadcasts. His commentary on the connections and contrasts, on the internal signposting, and directions for viewer attention is both sensitive and illuminating; Williams explores "the flow of meanings and values of a specific culture" (p.118). Yet this part of his account is firmly within an exploration of text, he does not here acknowledge that his reading is one of many possible interpretive strategies, text is isolated from author and reader.

TELEVISION AS CONSUMPTION

In a short account Williams can only briefly touch upon the context of consumption. His comments characteristically relate to the liberatory possibilities of broadcasting. Drawing a parallel with the emancipatory, if unintended, consequences of mass literacy, he comments on the tension between domination and use.

It was not only ruling or commercial groups who recognised the problems of communication in conditions of complex or of privatised mobility. It was also the many people who were experiencing this process as subjects. To controllers and programmers they might seem merely objects: a viewing public or a market. But from their own side of the screen there was a different perspective: if they were exposed by need in new ways, they were also exposed to certain uncontrollable opportunities. This complicated interaction is still very much in the process of working itself out. (p.131)

The key strengths of this early and innovative attempt to subject an apparently technical practice to cultural analysis are, firstly, that television is presented as an arena of class contest, available for analysis as other social phenomena.

Secondly, Williams' essay suggests a way of containing a diversity of theoretical approaches. He distinguishes between economic and cultural form and context in his analysis. The tools to integrate these different modes of analysis are not, fifteen years later, any more developed or available at the level of grand theory than they were then. However, Williams' focus on television, on one historically specific set of practices in Britain and America, does serve to integrate these approaches at the level of the particular.

Thirdly Williams provides an account of a technology which prioritises class relations and which does not

defer to technical expertise or to the efficacy of technical products. He is concerned both with the media and with the technology of that media.

Published in 1974, this was and remains new ground for a cultural studies text. Williams privileges the social over the technical. The dangers of this are that the physicality of television technology is evaporated altogether.

Regrettably, for the purposes of this thesis, the breadth of Williams' conception has never been incorporated into the development and elaboration of media studies. Recently however there has been an attempt to re-insert the notion of technology into the analysis of media.

A CULTURAL STUDIES APPROACH TO TECHNOLOGY - MORLEY AND SILVERSTONE

In their paper "Domestic Communication - technologies and meanings", Morley and Silverstone address the phenomenon of television. Their target is the limiting way in which television and other communication and information technologies are discussed in media and cultural studies, and they try to suggest a mode of analysis which goes beyond these studies. The approach is not an explicitly marxian one, although their general approach suggests they are within a broadly marxian tradition of cultural studies.

Essentially Morley and Silverstone attempt to explore television as a consuming practice in households. They have a two-fold notion of consumption - the

consumption of technology, and the consumption of text. They argue that television, like other communication and informing technologies, is the bearer of two sets of meanings - one related to the technology, one to the text.

The first set is the meanings that are constructed both by producers and consumers around the selling and buying of all objects and their subsequent use in a display of style, as a key to membership of community and subculture. (p.36)

The authors present a second set of meanings as those related to what is conveyed by the technologies, the programmes, the message. They insist both sets of meanings are open to negotiation and transformation. With this duality of meaning Morley and Silverstone draw attention to the material and symbolic dimensions of television technology. The authors do this by outlining some of the ways in which television may be analysed as a domestic technology: for example, in terms of the shifting balance between public and private spheres and the ways in which broadcasting (and here they mean radio as well as television) has emphasised the domestic. Morley and Silverstone relate their comments to the social divisions of household and families. They speak of the

process in which leisure time has increasingly been located within the home, as opposed to within the public sphere - on the street, or in the pub, or cinema - is one in which broadcasting itself has played a key role, by increasing the

attractiveness of the home as a site for leisure.
(p.37)

Morley and Silverstone argue that the entry of new communication technologies into the home is marked by their differential positioning of men and women, and their differential incorporation into masculine and feminine spheres of activity with the home. This can be seen in relation to a number of technologies; speaking of radio, the authors comment that

the domestication of radio was a gradual process in which, from being initially a disturbance which separated men and women in the household, it came to be accommodated to the household's spatial and social relations. (p.38)

By such means Morley and Silverstone usefully point to the transformations of radio, to remind the reader that radio (against its apparent givenness) was not initially a consumer durable - it was a technical and male preserve. The radio has become so accommodated, so incorporated into everyday life that its initial male ownership now seems strange.

Morley and Silverstone comment on the extent to which family ideologies intersect with state regulation of the domestic sphere, through the regulation of television, for example, the regulation of scheduling to "protect" children and the "family" - as if parents were irresponsible and incapable.

The indicative analysis which Morley and Silverstone give opens up the possibility for a range of

exploration in this area. It is, for example, interesting to speculate on the way more recent technical goods have been introduced into the home and are located within gender specific spheres of activity, temporally, spatially, economically. Their brief paper opens up possibilities for exploring the ways in which broadcasting (along with other domestic technologies of communication) may be understood as enmeshed with the internal dynamics of the organisation of domestic space, primarily with reference to gender relations. It may, for example, be argued that the very spatial organisation of households is, to a significant extent, grouped around who uses what hardware, and who shares the use of what technical artefacts.

Morley and Silverstone mark out another indicative area - broadcasting's role in the social organisation of time. This could include not only the ritual elements of arrangements (of the type, 'we have our tea before the news') but they also call attention to the other ways in which television schedules intersect with domestic schedules.

The unobtrusive ways in which broadcasting sustains the lives, and routines, from one day to the next, year in, year out, of whole populations.
(p.41)

This consideration of television does not, as yet, concern the content of programmes. This presents a different order of difficulty. Within Communications Studies television has conventionally been analysed in terms of reading or reading the text. This approach

assumes that viewers are all concentrating, rapt with attention, and that there is a strong message. Morley and Silverstone begin to point out the many other features which shape what sense viewers make of television output. The context clearly shapes interpretation, where viewing takes place, in what company. The mode of viewing is also not straightforward, the authors comment

what is necessary is to examine the modes and varieties of viewing and attention which are paid to different types of programmes at different parts of the day by different types of viewers.
(p.45)

Morley and Silverstone direct attention to the complex processes of making meaning, and the ways in which it is necessary to be quite specific about different media.

Print, radio, television, video and the computer all require different skills and different modes of attention. This is not to say that the technologies themselves determine how they will be used, but that they create different possibilities for use. (p.45)

In a further comment on the processes of making meaning, Morley and Silverstone point to the ways in which and the extent to which viewers make meaning through identification with the television.

Identification implies not just a one-to-one correspondence between a viewer and some favoured

character, but a more general identification at a number of different levels, between what appears on the screen and the lives, understandings or emotions of those who attend to it. This does not apply only to a realist text. One can hardly imagine any television text having any effect whatever without that identification. (p.47)

Morley and Silverstone then see television as a complex economy of meanings. They attempt to bring together material technology with cultural text. Their outline paper suggests a variety of ways to explore (to use Richard Johnson's distinction) the television 'reader-in-text' and the television 'reader-in-society'. Their paper points to the rich avenues of enquiry around television, both as a material object and as a conveyor of messages. The highly specific character of their approach - communication technologies and domestic settings - is both within the spirit of the culturalist approach and a contribution to this discussion. Their focus on particular instances of domestic technology serves as a conceptual and methodological reminder that it is difficult to say anything very much about technology in general without re-inserting associations which limit the analysis.

Morley and Silverstone propose different modes of analysis for the technological artefact and the transmitted text. There is no attempt to integrate these approaches. Their focus is television, a technology with its own transmitted text. Yet the duality of their analysis extends, in principle, to a discussion of washing machines and central heating systems. Even in the absence of an explicit text

their notion of consuming technology points to rich possibilities for further work.

III A CULTURAL STUDIES OF TECHNOLOGY?

The purpose of this brief review of culturalist perspectives has been to explore the extent to which a focus on cultural production and consumption can contribute to a sociology of technology.

CULTURALIST MARXISM AND WORK

Firstly, a culturalist perspective necessarily re-inserts human purpose into the notion of work. Willis account provides a view of a humanistic concept of labour, his focus is particularly on the attempt to create meanings in work, whether at school or in employment.

Secondly cultural studies writers have explored a wide range of activities which, in terms of meaning and purpose, have the character of work. A culturalist perspective then calls attention to a broad concept of work - a concept that has the potential to embrace a broad range of paid and unpaid activities, and a similarly broad range of workplaces.

Thirdly, as the discussion of Morley and Silverstone has shown, the culturalist tradition offers, in an undeveloped form, a way of regarding technology which does not stress the artefact. In practice cultural studies writers have largely focused upon work with an obvious relation to the production and consumption of representation, whilst the focus of Marxian economy and labour process studies has been on productive work closely related to the production and consumption of value. However, the view taken here is that the

distinction, between value and representation rests on the mode of analysis, not on the objective character of particular kinds of work. It may, in practical terms, be easier to consider the cultural form of film as opposed, say, to that of the products of engineering work, yet there is no necessary priority here. Similarly it may, in practical terms, be more straightforward to explore the economic and organisational character of industrial workers, yet there is nothing (except difficulty) which in principle prevents an exploration of the relations of production taking place whilst watching television -indeed Jhally and Livant (1986) attempt to do precisely this.

Fourthly cultural studies writers offer some clues to the ways in which economic and cultural modes of analysis may be combined. Both Willis and Winship suggest that work itself has both a productive and representational aspect. Within culturalist writing this point has yet to be fully developed, where technology is concerned there are particular resistances.

By an association with hardware and with paid production, technological practices have been associated with value rather than representation. Yet even within the physicalist and productivist enclave of technological practice there can be no work which is simply "economic" any more than there can be work elsewhere (in television, or magazines, or sub-cultural groups) which is solely "representational".

By seeing a culturalist perspective alongside a labour process one, it may be possible to begin to see how the

constitution of the category "technology" take places on and off the shop floor.

CULTURALIST VIEWS OF PRODUCTION AND CONSUMPTION

As for the relations between production and consumption, Richard Johnson presents the view that the human activities of producing and consuming apply as much to cultural forms as they do to commodity products. The danger of this duality is that the cultural can be seen as a set of detached meanings, or significations, rather than an integral dimension of material life, of human work. Each of the writers considered here have adopted different strategies to relate their exploration of cultural form to the economic structure of class or family relations.

Williams' essay on television marked out the ground for an approach which brings the ownership and control of property into closer relationship with the production of cultural form. For Winship the work of consumption embraces not only the representations of femininity but relates as well to economic consumption, of magazines and the products which they promote. Paul Willis' account of the production and circulation of sub-culture refers directly to the reproduction of labour power itself. In their comments on technology as a conveyor of meanings, Morley and Silverstone's account of the consumption of technology relates directly back to commodification and use value, although they do not express this aspect.

CONCLUSIONS

It is not the intention here to see a culturalist perspective as integral to the reading of Marx given in chapter four, rather to explore an alternative marxian tradition in sociology which may contribute to a sociological understanding of technology. There are three strengths which cultural studies appear to offer, albeit in an undeveloped form:

Firstly the possibility of taking technological products not as artefact but as text. (For an attempt to "read" the microcomputer in this manner, see Haddon 1988.) This implies a de-emphasis on "authorship"; a notion of an implied reader; and a recognition that a number of "readings" are possible. On the face of it the notion of different "readings" for artefacts seems strange. Yet if we cannot think in terms of a range of readings or uses for particular pieces of hardware then a determinist view of artefacts is admitted. Even very dedicated artefacts may arguably have other possible readings (as implied by Williams) but often these are obscured by the narrowly specific contexts within which such technology is encountered.

Secondly, by placing cultural production alongside material production a culturalist approach suggests ways of grasping the broader social shaping of technology. The writers discussed above have acknowledged the ways in which school playgrounds and women's magazines and homes may be seen as workplaces, as sites of cultural production. This raises the intriguing question of what sites, what work, contributes to the category "technology"? If

playgrounds and women's magazines can be linked to the production of gender relations, what areas of cultural work contribute to the production of "technology" and technical expertise?

Thirdly the culturalist approach has the potential to direct attention to the activities of symbolic production and consumption. To the ways in which we construct the category "technology" - collectively and individually in work and in the ways we make things part of our symbolic universe. A culturalist approach helps us to consider the ways in which the reservoir of available meanings may be used to make sense of, say, new technology; how to render that technology into something familiar, thinkable, or sayable, or recognisable through metaphor. This implies that we think about new technology not in terms of the new but in terms of how the new is absorbed, indeed the work of absorption. (An illustration of this process may well be the successful re-launch of the Amstrad PCW 8256 as a word-processor, as familiar as the typewriter, when its first unsuccessful launch had been as a computer.)

This thesis is concerned to explore the sociological constituents of technology - both as a set of artefacts and as a cultural form. Yet as it stands, the project to work with both value and representation, is too unwieldy. Some specificity is required to mark out areas for discussion. A focus on particular technologies can provide one way to limit exploration, another is to explore the ways in which technology is constituted within specific social relations. Thus the focus in the next chapter is on gender divisions, as we

shall see this is more than an ad hoc or expedient choice.

PART THREE

CHAPTER SIX : TECHNOLOGY AND GENDER RELATIONS

This chapter turns to feminism to explore the strengths it has to offer a sociology of technology. There are good ground for optimism. During the last three decades feminists - social scientists, artists, activists - have been successful in challenging many taken for granted areas of social life. Three areas of that success appear, in the light of previous discussion, to have particular relevance for a sociology of technology:

Firstly, feminism is not tied to production or to narrow conceptions of the economy. Within social theory feminists have challenged productivist assumptions about work and production. And at the level of both theory and political action feminists have asserted the economic and sociological importance of unrecognised labour - unpaid, domestic, reproductive.

Secondly, feminist literature has emphasised the subjective and the interpretive. A wide range of feminist writers, from psychoanalytic and ethnographic traditions, as well as novelists, researchers and social theorists have sought to recognise personal experience and personal life as valid sources of knowledge. Against the abstraction and formalist theorising associated with public life and events, feminists have stressed the equal importance of more immediate, small scale and expressive aspects of social life. This augers well for a sociology of technology that has hitherto been characterised by a lack of concern for subjective interpretations.

Thirdly to a physicalist view of technology, feminism offers a profoundly anti-reductionist tendency. By reference to a sex/gender system, feminist writers have been able to force a crack in the association of women (as a cultural category) and biology (as an apparently certain body of facts and theories). Just as sex stereotypes rest upon biology for their legitimation so, arguably, do technology stereotypes rest upon an equally partial view of production. The aim here is to bring this de-reifying insight to bear on the objectification of technology.

The purposes of the following discussion are three-fold: firstly to draw a comparison between the reductionist strands in debates about women and about technology. Secondly to move away from the masculine emphasis of productivist analysis and, drawing upon the previous chapter, to point to sites where technology is constituted, but which are far removed from assembly lines and technical knowledge. Thirdly to indicate the methodological problems which arise when the debate about technology stray from the well marked areas of class contradictions in paid production.

The chapter proceeds as follows. A first section reviews the ways in which feminist sociology has approached the topic of technology. A second section departs from social theory to consider the contribution of feminists working in other areas - in science fiction and in technical workplaces. A concluding section assesses the perspectives which feminism can make to a sociology of technology.

I : TECHNOLOGY IN FEMINIST SOCIAL THEORY

The conventional assumption is that women are estranged from technological practice; certainly they are largely excluded from status-rich sites of technological design and manufacture. Yet, as I argued in chapter five, cultural products are constructed in a number of different workplaces, both waged and unwaged. What influence can women wield in the constitution of "technology" and technical products? And to what extent can an emphasis on the gender dimensions of technology help to subvert the rigidity of technological products?

With few exceptions, the literature on women and technology is uninspiring. Women do appear to have low levels of participation in the production and consumption of the technology of paid production. And women are certainly absent from high status science and engineering jobs: as they are from all other high status jobs. That is not in question; but the explanations given for those low participation levels are open to debate.

Feminist writers have given very diverse accounts of women's exclusion from technology; here are some examples:

- women are denied access to techniques, to schooling, and to training programmes, to the formal and informal means of becoming familiar with technology. (Kelly 1981, Cockburn 1984)
- women are denied access by men (both management and workers) to the paid workplaces of scientific and

technological production. (Hacker 1981, Cockburn 1983)

- men and women may use technology differently. (Turkle 1984) This suggests that men and women may develop technology in different ways.
- most scientists and engineers are men (EITB 1981)
- the domains of scientific and technical knowledge have developed both a positivist and masculinist character, thereby excluding women from conceptual participation. (Keller 1985, Harding 1986)
- the history of technology neglects women as inventors of technology. (Stanley 1981)
- women are denied recognition for the technical skills they do have. (Zimmerman 1982)

Others simply assume that women are disinclined toward technology, do not take the opportunities available to them, or have insufficient strength to engage in some forms of technologically related work.

Still others argue that women have separate but distinctly different technical skills and aptitudes. The examples are usually drawn from home, child care, or medicine. (Boston Women's Health Collective 1978) The pseudo-essentialist association of women and nature is often evoked in this context.

Only the last of these approaches questions the concept of technology at all, and then substitutes another taken for granted - nature.

The prevailing assumption again is that technology is hardware. Here, too, the products of technological work

are taken to be the sum total of "technology". The network of relations in which the cultural product is embedded is neglected in favour of the artefacts, the dead labour. And the political consequence is again to accept unchallenged the claimed efficacy of the product. (Feminist commentators have been no different from their more traditional counterparts in this regard. Appendix III comprises a brief review and discussion of the ways in which feminists have written about new technology.) I want to argue a parallel between the category "technology" and the category "woman", that here, as elsewhere, fixed facts dissolve on inspection into sets of practices which can be influenced. But here there is a double problem. On the one hand the complexity of the category 'woman'. On the other, the ambiguity of 'technology'.

'Woman' is evoked as an economic category, a familial category, a status and subjective category, quite apart from race, class, and age differences. All women may be said to occupy and suffer various inferior status positions. But the specificities and relativities of these inferiorities are so diverse that the commonality of 'woman' keeps slipping away, with only a resort to biology as a defining difference. The categories of male and female are constantly changing, from context to context, and through time. We can have no fixed taken for granted assumptions about these constructs - yet they act upon us with the apparent certainties of physical laws.

'Woman', a cluster of social categories, is a difficult topic to grasp. The ascription 'technology' is similarly full of paradox. Why, for example, are the

chemical processes, stainless steel tools, and electrical gadgetry of hairdressing not often seen as technology, when television repair is associated with technology? And yet, relative to the routinised procedures of television repair men, hairdressers need to exercise more decision making and problem solving in their work. Two workers in a factory - one operating an industrial sewing machine, one an industrial sanding machine; yet often only the latter is seen to be working in a technical area.

It does not seem possible to distinguish technology by reference to the complexity, power or usefulness of the artefact. And what things get called is not the heart of the matter. It may be that the approval in the label 'technology' has more to do with who is using it, in what statted context. It has been argued that jobs are skilled because men do them (Phillips and Taylor, 1980). Are products made 'technology' when men use them? The constitution of 'woman' and of 'technology' are not separate practices; similar, even congruent, power relations obtain. Men's work is often defined as technical, technical work is seen as men's work (and the obverse, women's work is often defined as non-technical, non-technical work is seen as women's work). What practices then sustain the definitional power of 'technical men'?

Gender Divisions in Technological Work

Commenting on the absence of women from engineering at professional and technician levels, Cynthia Cockburn, writing in the NATFHE Journal, argued that:

Men have made of the technological sphere a masculine fortress. Technical competence is part and parcel of what we think of as 'masculinity'. Unfortunately that means that technical incompetence is intrinsic to what we know as 'femininity'. Women are therefore faced with a hard choice: get to grips with technology, become one of the lads and lose your lovability, or keep your technological naivety and be the sort of woman men like. (NATFHE Journal, No.8, 1984 p.40)

Cockburn reminds us of the close association of the technical with masculinity is seen as a major factor in the sustained exclusion of women from the technical workplaces.

In Mussolini's Italy women were banned from working with machinery because it upset the order of Nature and had the effect of emasculating men. Even in Britain today men do seem to feel unmanned by women who demonstrate an average competence with a toolkit. They certainly contrive to make women feel unwelcome in technological workplaces, using means both subtle and unsubtle. (NATFHE J.p.40)

A worrying circularity creeps into feminist analysis at this point. Technology - always seen unproblematically as machinery by Cynthia Cockburn - is infused with masculinity. The culture of femininity both makes women and, at once, excludes them from technical competence. Yet conventional definitions of technology concentrate on masculine workplaces (and thus deny recognition to those areas where women do

wield tools and technique purposefully). Cockburn does not challenge these conventions but argues that technology can be torn away, deconstructed from its masculine character. That leaves some doubt over what exactly is being liberated for use by women.

... there is really no need, in all humanity, for a technical workplace to be a macho club, a carefully nurtured fraternity with a culture of soft-porn and hard language. But so long as it continues to be so, it is no good recruiting women in token ones and twos and expecting them to be grateful. (NATFHE J.p.41)

Either technology is constituted within relations of masculinity, by and for men - in which case it will be necessary to be quite clear about the advantages which may accrue to women having control of particular technologies. Or masculinity is epiphenomenal to the technical workplace - in which case the deep socialisation of femininity is not a major excluder.

Women's unequal access to technical jobs, and the oppressive consequences of scientific work for men and women, are matters of important political concern to feminists. At heart, this concern is not reducible to the number of females in workplaces nor is it realistic to expand concern to the production of women-centred knowledge: it is a question of the distribution of power and choice in contemporary society. Liberal, socialist, and radical feminists have attempted to uncover the ways in which women are persistently discriminated against in the distribution of power associated with technical practice. Pointing

to women's unrecognised involvement in technical work may widen labour definitions, it will not necessarily change power and status hierarchies. Similarly, chipping away at the legitimacy and presumed efficacy of expertise - as feminists have done in say medicine or defence debates - will not necessarily confer power on the alternative or oppositional forms of treatment or military strategy.

A crucial question here in analyzing feminist approaches to technological practice, is whether the intention is to dismantle power conferred by technical exclusivity (by demonstrating its weakness) or to re-allocate technologically sustained forms of power by bringing it under the control of those who it most affects. The latter implies the progressive transformation of existing technical divisions of labour and technical knowledge, to give greater access to culturally appropriate technical experience. The Technology Network outlined later in this chapter provides one small example of the difficulties of doing this.

Physicality, Technology and Gender Relations

As I have tried to suggest, feminist writers have made a number of attempts to develop a sociological purchase on women's relations to technology. There are, however, significant silences in this body of literature. Few writers have explored the ways in which the construction of gender interrelates with technology; few, if any, have adopted a critical approach to what passes for technology.

As to the first silence, that of gender relations, there are many texts whose focus is women. These either comment on women's absence from technical workplaces, or women's oppression by technology, or, more positively, celebrate women's inventiveness and different skills. Very few texts on technology address the topic of masculinity, or even femininity. There are two exceptions here: Cynthia Cockburn, an aspect of whose work is discussed below, and Sherry Turkle, whose work is discussed in Appendix I.

As to the second silence - the absence of critical debate about the category "technology" - there have been some attempts by feminists outside sociology to posit alternative technologies, and more democratic relations of technological production. These are discussed in the second part of this chapter.

The writer Cynthia Cockburn warrants particular attention here for two reasons. Her work exhibits a strong sense of the construction of gender relations rather than a concern to simply chart the absence or presence of women. Secondly Cockburn is a meticulous researcher who, despite a rather traditional marxist approach to the concept of work, obtains purchase on the cultural by grounding her account in detailed interviews with participants, with those who work at the site she is investigating.

As for technology, Cockburn has consistently and uncritically identified technology with the hardware of paid production. In The Material of Male Power, a paper first given to the Annual Conference of the British Sociological Association in 1980, Cockburn

charts the ways in which class and gender intersect at moments of technological change. Of particular relevance here is the way in which Cockburn has recognised the physicality of machines and of male workers as a matter for sociological concern. This aspect of her work is discussed below.

The Physicality of Men and of Machinery

Cynthia Cockburn attempts to bring physicality into a sociological account of gender and technology. Her research centres on newspaper composing rooms. With an emphasis on the class and gender relations in the new technology of printing, Cockburn provides a richly detailed and theoretically challenging account of the context of technological change.

There have been two significant changes in print technology, from cold type to Linotype hot lead and again from Linotype to computerisation. Cynthia Cockburn examines these two historical shifts in terms of the intersections of class and gender. She points to the discontinuities between feminism and marxism, between familial and employment relations, and argues that some light on the interrelations of these social forces may be gained by a fuller understanding of the corporal power of men. In The Material of Male Power Cockburn examines how this power finds expression in the closed shop of print work. Exploring the gendered character of technology, she points particularly to the physicality of men and their physical command of machinery.

The physical reality of men, their muscle or initiative, the way they wield a spanner or the

spanner that they wield, these things are somehow still largely absent in our theory.

(Cockburn, 1980 p.3)

Cockburn argues that an analysis of the concept of corporal strength and its historical deployment is an inescapable strand of the politics of gender.

We cannot do without a politics of physical power. By physical power I mean both corporal effectivity (relative bodily strength and skill) and technical effectivity (relative familiarity with and control over machinery and tools).

(Cockburn, 1980, p.6)

Cockburn presents the view that the biographical circumstances that foster bodily strength and effectivity in males, the social contexts which constitute skill definitions in paid and unpaid work contexts, and the consumption of tools and machinery come together in the particularity of organised male, manual work in the printroom.

Corporal Strength

Cockburn has, with some courage, addressed the topic of physical effectivity from a feminist perspective: the question of bodily strength and its deployment forms a significant aspect of the class and gender constituents of technology, since, in popular discourse, strength differentials are so frequently evoked as a legitimate reason to exclude women.

Cockburn has a notion of strength which is gendered yet, as we shall see, despite her strong theoretical and empirical base, she takes three categories as largely given: strength, strength differentials, and technology.

Cockburn argues that the social product, bodily strength, is used by males to oppress females at home, at work, and on the street and that organised print workers evoke their superior strength over women to protect their skilled exclusivity of employment. There are a number of unresolved issues here.

Firstly, Cockburn assumes that men have a distinct strength advantage.

To say that most men can undertake feats of physical strength that most women cannot is to tell only the truth. Likewise it is true to say that the majority of men are more in their element with machinery than the majority of women. Neither of these statements is necessarily biologicistic or essentialist.

(Cockburn, 1980, p.6)

The exercise of strength and technique may be more context specific than Cockburn suggests. Evaluations of strength are embedded in particular circumstances; why, for example, is lifting weights more recognisably "strong" than, say, lifting an ailing parent? Cockburn seems to take claims for physical strength at face value and to minimise what is arguably the major dividing force, technique and the opportunity to acquire technique.

There is, too, a danger of fetishising not only strength but also the category 'woman'. By generalising about relative physical effectivities between men and women which occur in differing relations of production and diverse social contexts, the concept 'woman' is reproduced with all its disabling ideology intact.

Secondly, Cockburn argues that, through the design of machinery, men exploit their corporal superiority to exclude women. She assumes that print machines do require a particular kind of heavy muscular power.

The acquisition and development of bodily strength is an evident thread in the gender and class politics of this labour process... Men having been reared to bodily advantage make political use of it by defining into their occupation (and thereby barricading it against women) certain tasks that require the muscle they alone possess. In composing, the lifting and carrying of the forme is a case in point. Nonetheless many compositors found this aspect of the work heavy (it was felt to be beyond the strength of older men) and they were always torn between wishing for unskilled, muscular male assistants and fearing that these, once ensconced in part of the job might lay claim to the whole.

(Cockburn, 1980, p.18)

Here she links the discussion of differences in bodily strength and technique to a description of how print unions have used these differences to maintain their

position relative to women. Here Cockburn takes two notions as given and accurate: There is a clear distinction to be made between male and female strength differentials in particular contexts and the representation of physical strength requirements made by organised print workers. An additional slippage occurs between these representations and the actual strength demands made by the design of the heavy metal forme and its associated processes of production. Strength certainly has been evoked to the advantage of organised labour in some contexts - but so has skin pigmentation. The evocation itself is no evidence of the substantive importance of these physical differences. Within the context of print work it is evident that organised labour has been willing to turn any cultural distinction into an apparently political advantage. This is not to dissolve away the strength and technique required to life the forme, but, as Cockburn herself points out, that too came about as a protectionist strategy by the organised workforce.

Against the unskilled male, defined as corporally stronger than the skilled, compositors defended their craft in terms of (a) its intellectual and (b) its dexterity requirements. Against women, with their supposed superior dexterity, the skilled men on the contrary invoked (a) the heavy bodily demands of the work and (b) the intellectual standards it was supposed to require. (Cockburn, 1980, p.18)

No doubt print technology has, in the past, demanded particular competency in lifting technique. Logically that in itself would not exclude a number of women

workers. They have been excluded by the organisational power of the composers to limit access, using arguments about the supposed relative physical weakness of a group of non-members.

In her attempt to situate technology in the gender relations of the print room Cockburn may too readily attribute some epistemological priority to physical strength and technique. She certainly runs the risk of evoking a decontextualised notion of strength.

Strength is an attractive concept for Cockburn. She is concerned to transcend the theoretical polarity of economics and ideology and appeals to a concept of the material.

Seeking to avoid idealism, to bring considerations of women's oppression firmly down from the ideological to the material, we search this way and that for a purely economic source of female exploitation.... The proper complement of ideology is not the economic but the material. And there is more to the material than the economic, it comprises the physical also, physique and technology as well as wealth. What is more, the physical is effective in the family, at work and in society at large.

(Cockburn, 1980, pp.5-6)

Bodily strength is theoretically attractive for Cockburn's argument since it appears to ground 'the material' in some substantive and effective practice - the differential rearing of males and females. But the solidity of bodily effectivity may be more apparent

than real. Evaluations of strength cannot easily be separated from the social definitions of technique; and the acquisition of technique requires access to relevant contexts, not always equally available to men and women.

Differentials in strength and its associated technique do clearly feature in the class and gender politics of some areas of technical work. Yet male physical effectivity (perhaps as much an outcome than a cause of these contests) cannot provide an anchor for technical superiority. The notion of physical effectivity is itself open to critical examination, especially in regard to its measurement, historical specificity and task particularity.

Cockburn has attempted to show how both class and gender relations at work contribute to the social shaping of production technology. This is a useful step on from the unacknowledged masculinity of the majority of labour process studies. Yet her account is ultimately flawed by a taken for granted view of strength, of strength differentials, and of technology. Inexorably she is led to a pessimistic conclusion. In her account of bodily strength Cockburn appears to construct a view of strength which is absolute and uncontexted rather than socially defined and variable.

Cockburn uses the category 'technology' unproblematically. She does not discuss what would, or would not, count as technology in composing rooms, or in marxian or feminist theory. By equating technology with machinery, by adopting a taken for granted conception of technology, she has inevitably

re-introduced notions of masculine technicality back into the analysis.

II : CHALLENGING DEFINITIONS OF TECHNOLOGY

The view has been presented here that feminist social theorists have provided a relatively disappointing commentary on technology. Yet outside social theory there have been attempts to challenge gendered definitions of technology.

The work of feminist movements in all spheres of social life can be seen as challenging the facticities of biological givens. Attempts to dissolve sex differences into relations of gender - which are open to contest and campaign - have occurred in technology-related practices as elsewhere. Feminists have fought for girls' and women's access to curricular choice in schools and colleges; for women only training programmes; for greater feminisation of scientific and technological employment; and have challenged stereotypical representations of sexual divisions of technological labour.

Rather than consider questions of access to taken for granted areas of technological practice, I want to concentrate on those feminists who appear to challenge the definitions of technological practice.

Untrammelled by narrow notions of production, the only systematic attempt to challenge technological practice comes not from academic sociology - where feminists adopt positions similar to their male colleagues - but from feminist fiction and from activism. As we have seen, feminist sociology has provided little that is innovatory in their comments on technology. This is a curious and contradictory failure in the light of the

radical theoretical re-appraisal which feminist sociologists have conducted on many areas of social life. Technology is so closely associated with masculine power that one could reasonably suppose this stronghold to be a focus for feminist attack. This has not been the case. Whilst the marxian and culturalist perspectives have produced no feminist commentary on technology, feminists have expressed their views of technology in fiction and in practical action.

One such challenge comes from feminist science fiction. Most writers in this genre assume that when men are in charge of technology then the abuse of power and destruction is the outcome. Where male science fiction puts emphasis on human abuse of science and technology, feminist storytellers presuppose male abuse of the instruments of production and destruction. Feminist writers also show how women are controlled by men being in control of technology; in, for example, Zoe Fairbairn's Benefits control of women is secured by contraceptive implantation.

Most conventional science fiction focuses on future hardware whilst retaining the relationships of the white middle class (described by Joanna Russ as 'intergalactic suburbia'). Feminist writers however largely focus on different modes of relating and hardware remains in the background. (See, for example, Ursula le Guin's The Left Hand of Darkness and The Dispossessed).

Feminist writers speculating about a technological future take one of the following positions. Firstly,

they may reject completely existing and future technology because they are tainted by male control. In an imagined primitivism, where life is lived 'close to nature', a version of alternative technology frequently appears - women characters have telepathic powers, talk with rocks and the wind, sometimes communicate with animals, and are generally in blissful harmony with nature. Such worlds explicitly develop the supposedly feminine qualities of caring, sharing, and loving and, in the process, attempt a vehement critique of man's use and abuse of technology.

The dangers of biological determinism in this approach are evident; the frequent appearance of telepathy as a form of technology in feminist science fiction is related to the presumed intimacy between women and nature and to ideas of female creativity and to its suppression by the domination of patriarchal technology. The concept of patriarchal technology slips quickly from gender relations into the biologism of men-as-a-class; yet outside literature it is often difficult to specify the character and extent of men's conscious or conspiratorial control over technological practice.

A second mode of feminist science fiction confers control to women and extrapolates to technological forms which make life more comfortable. For example, in Sandi Hall's The Godmother a group of women use computers to challenge the interests of a big business corporation. In Suzy M. Charnas' Motherlines - a story of women survivors in the wilderness - a group of women perfect a technique to reproduce without men.

The difficulties of this approach are that taking control of technology requires an ahistorical leap, and even if strange events did provide the conditions for some women to be powerful in a particular technological area, taking control does not necessarily dissolve skill hierarchies or relations of expertise.

The third kind of feminist science fiction offers an transformative view of technological practice. In Woman on the Edge of Time, Marge Piercy offers a critique of male controlled medical technology and the race and class dimensions of its constitution and use. This critique is integrated into a utopian vision of technological development which includes production for usefulness within non-hierarchical social relations. Piercy's other world - a federation of villages with decentralized agriculture and industry - combines harmony with the physical world with a related spirituality in daily life. Her utopia embodies high-tech gadgetry (for necessary, repetitive jobs) with low-tech methods of ecological conservation. Neither Woman on the Edge of Time nor the similar Dreamsnake by Vonda N. McIntyre offer a vision of technology entirely under the control of women. They present societies where gender relations are relations of equality. This provides a more satisfactory solution to the issue of power; power is transformed rather than reversed to women-centredness.

Feminist science fiction is not intended to be a programmatic blueprint for a more equal society. Essentially and importantly this genre provides visions to question the taken for granted and to nourish the possibility for transforming existing technological

practice. As a series of representations, feminist science fiction makes one contribution to challenging the gender relations of technology.

Other feminists have taken more practical initiatives to contest masculine strongholds in manual skills and technical training.

A fragile network of women's workshops has opened around the country attempting to train women in such areas as carpentry and joinery, plumbing, painting and decorating, and electronics and computing. The explicit thrust of women's training workshops is two-fold: to enable women to enter areas of paid work and to gain access to men's rates of pay; and to empower women by enabling them to acquire practical skills to minimise dependency on men with technical experience.

Such initiatives come closest to reconstituting relations of technological practice, even though the explicit purpose is to give women entry to skills. Workshop syllabi are usually traditional - but the means of recruitment, pedagogy, and working relations are certainly not. Childcare, group and individual support, training and travel allowance, flexible hours, and the importance of relevant practical experience have all been seen as integral to the teaching and learning process - a far cry from the technical training experiences of young men. Setting up a women's workshop is no mean achievement. Funding, staffing, premises and continuity are very difficult to obtain. Yet if such initiatives do not grasp the implications of their feminist practices, their changed relations of production, then women trainers will be

limited in how far they can transform definitions of technology.

Here is an account of one small attempt - a technology network - to change the relations of technical training and technical work. What follows is a description of a practical initiative. It is included not to celebrate the small scale and the particular, but rather to draw attention, in a relatively concrete way, to aspects of the more theoretical discussion running through this thesis. The account is included here, firstly, because it highlights the way in which an objectivist focus, an association of technology with hardware, intersects with the gendered division of labour in technical workplaces. The account also demonstrates the immense difficulties of giving a sociological account of the technical workplace.

CHANGING TECHNOLOGY: a Technology Network.

Technology Networks were part of the socialist initiative of the now defunct Greater London Council (GLC), part of the general attempt to develop London's local economies, to combat London's high levels of working class unemployment, and to counter Conservative Government policy by providing some positive examples of what a people-centred Labour administration could do. It should be noted that these aims carry their own contradictions; they seek to achieve success in both wealth generating and 'community' production terms and thus meet the tensions of egalitarian technical production. The network staff were concerned to provide an alternative to unemployment, to facilitate

community access to productive facilities, and to explore the conceptual and practical uncertainties surrounding the process of changing technological practice.

BACKGROUND TO THE CONCEPT OF A TECHNOLOGY NETWORK

The inspiration to set up half a dozen technology networks came from Mike Cooley, famous for his work in co-ordinating the Alternative Plan at Lucas Aerospace. In Architect or Bee? The Human Price of Technology Mike Cooley has attempted to alert readers, especially trade union readers, to what he sees as the dehumanising dangers of technological change in industry and to describe ways in which technology can be harnessed for more liberatory purposes. In association with Professor Rosenbrock at Manchester University Cooley has, for example, developed a notion of "telechiric" technology - where the design of hardware is shaped by a concern to extend the capacities of the human operator. On this view technology enhances the capacities of workers rather than the Taylorist aim of fragmenting and deskilling. Drawing on Braverman, Cooley sees the oppressive features of industrial technology to stem from Taylorist managements in capitalist enterprises. Like Braverman, Cooley developed his theories as a trade union activist in engineering workshops.

After his dismissal from Lucas Aerospace, Cooley joined the Greater London Enterprise Board (GLEB), a wing of the GLC. There Cooley developed the notion of Technology Networks as a practical expression of his ideas about liberatory technology. His intention was to give Londoners some means of access to the

accumulated technical expertise in the Universities and Polytechnics around London together with some practical means to give expression to the technical creativity of local people. Some Networks were technically specific, focusing on new technology or energy, whilst others were geographically specific to North East or South East London. Each Network necessarily took on a particularity determined by local circumstances. Unlike the specialist networks, Thames Technet was particularly concerned to establish links with local communities and this led to particular emphases in the development of the network.

THAMES TECHNET

Thames TechNet attempted to provide conditions within which local people, consumers and producers of technology, could work together as equals. Initially this required a combination of community work - to identify groups, individuals, projects - and development work. Once formed, project groups would be given access to people with relevant skills and experience. Groups may need the advice of marketing or legal people, technicians, designers, engineers, accountants, and others. Often Polytechnic students became involved in projects; at other times Polytechnic lecturers shared their experience with project groups. This attempt was conducted under benign, although temporary circumstances and represented some of the most favourable conditions within which less exclusive processes of technical production might flourish. Benign though the circumstances were, they were not without constraint. The Network was developed within already existing structuring relationships amongst which gender and

expertise feature prominently.

From the start the Network was conceived of as a practical reconsideration of the processes of technological production and consumption. The Network proposal began with this firm statement, addressing both human work and production:

... the human resource of many workers, both paid and unpaid, in and out of employment, is needlessly cramped and confined within the rigidities of the social division of labour.

... more equal working relations between makers, and between makers and users, can produce more useful products.

This initiating document then went on to describe the means by which the Network intended to foster collaborative modes of product generation: to bring together people with needs, and people with skills, with enabling plant and expertise.

During the initial phase, the Network engaged in start-up activities: moved into new premises, recruited staff, formalized the legal status, developed systematic procedures for handling aspects of the Network, tried to establish some public image through publicity, and met with a wide number of local groups. (An account of my own involvement in the Network, together with a previously published account of the initial phase, form Appendix V).

The next two sections detail some of the gender dimensions of technological production at the Network:

firstly in terms of the relentless focus on products rather than processes; secondly, in terms of the work processes, the differential recognition awarded to the labours of men and women employees.

THE FOCUS ON PRODUCTS

According to the initial GLEB concept, networks were supposed to focus on "socially useful products". That is not a simple matter. The concept of a "socially useful product" is difficult to realise. Some people see "social usefulness" in aids for disabled people or in play materials for children. Some see usefulness in resource saving projects, for instance in recycling glass or generating compost. None of these forms of usefulness is clear cut. A 'technical fix' for underprivileged groups or an appeal to "resource saving" (independent of whose resources are saved) are ambiguous areas for socialist action, it is not clear who the product is supposed to be useful to, or under what circumstances. Despite GLEB's rather ambitious notion of usefulness, staff at the Network thought that usefulness would be more likely to derive from making the purposes of consumption a central constitutive feature in the processes of production. By making the purposes of consumption a decision touchstone, it was hoped to bring producers and consumers together as people, to dispel the anonymity of the commodity market place, and, in the process to change both relations of production and products. (Background documents outlining the aims and project criteria of the Network form Appendix II.)

The uncertainties and ambiguities of the original GLEB conception of technology networking made life difficult. But a more pervasive danger was the tendency to see the Technology Network in simply entrepreneurial terms. New events are interpreted in terms of the old, and the Network was often treated as if it were simply an enterprise agency for small businesses, or an Research and Development service for inventors. As if it were possible to pursue socially useful production yet still retain entrepreneurial relations of production unchanged.

Many people visited the Network. They had usually heard about a number of developing projects. But their enquiries were often grounded in assumptions about the product, and the Good Idea. But technology is never just about hardware. Contrasting views of technology were frequently thrown into sharp relief. It was difficult to convey a sense of the many divisions of labour and experience which constitute the process of project development. Questions invariably revolved around the kinds of machinery, the engineering technicalities of the product, the novelty of the design. Here is one example of a Network project:

As a result of meeting with tenants' groups, one worker started talking with a local woman who was skilled as a Caribbean cook. A group of friends and relatives came together, called themselves Tropicana Cookshop, and moved into the canteen on Network premises. Members of the Tropicana group had found it difficult to find good cheap Caribbean food, especially take-away. They wanted to work together to provide that service, and 'meals on wheels' lunches to workers in local offices and factories. Translating their experienced need into practical provision called for high levels of organisation: finding cheap and reliable suppliers of fresh

and preserved food; devising ways of working together; discovering which dishes are popular; devising and costing menus; finding ways of packing and transporting hot food; doing a market survey and targeted advertising. All this was in addition to questions of cash flow, indemnity insurance, finding out about Health and Safety legislation and laws relating to the preparation of food for sale, forming a limited company, creating procedures for stock control and wages... These were ordinary working class people - black men and women whose considerable organisational skills had never been given public recognition, either in paid work or in educational qualification. The challenge, the task in hand for the Network lie not only in helping to set up a Caribbean cookshop, but also in the practical validation of experience. That is one way in which the Network attempted to subvert expertise, to change relations of production; but visitors' talk, the questions, returned to the thickness of metal, the best kind of clamp or cutting tool, or the computer configuration. These aspects of the work are necessary, but insufficient. Too often questioners stopped at the technical.

This project, and the many others in the Network, came about as the result of a number of already existing skills, experience, and knowledge of local needs. It is seductive to see 'a good idea' as a starting point, to see project development solely in terms of a physical product, as if technological change were merely a matter of a different design or production technique - rather than a consequence of changed working relations. Focusing on the narrow technicalities of the product makes the real work invisible. The product is only the tip of an iceberg. Like football programmes on television that focus on goals (and neglect, for example, practice and training,

the market in players, and the constitutive effects of sponsorship), an emphasis on hardware ignores the efforts of those involved in setting up a particular project. An exclusive focus on the physical product reinforces the apparent rigidity and immutability of technical work. At the same time those who do essential work, across and between technical labour processes, are structured out of the productive account. They are given no recognition. Whatever the project, someone has to work at developing relationships, ensuring that everyone has the information, tools and materials they need, keeping the impetus going - the kinds of invisible work with people and processes that women workers have learned, from the cradle, to do so well.

Here are some extracts from an interview with one such worker; the longest serving, most highly qualified and committed worker in the Technology Network. They point to the high personal costs of challenging taken for granted definitions and relations of technological work. More generally the following extracts re-pose the questions running through the previous pages:

What is the relation between emphasis on product and the practical, everyday inequalities of gender relations? Product-focused conceptions of work appear to minimise or negate the many kinds of necessary but low-status production work which working class people, and especially women workers, are required to do.

Who has the power to validate experience? Certain kinds of experience are recognised as technological

and, when certificated, such experience is transformed into expertise - with all the added material power that legitimation brings. Why are men's experiences more likely to be seen as technological?

(Note: Thames Technet was not set up solely as a feminist project, its aims were to work toward the democratisation of technology. The Network had an explicit concern to extend technological forms of power across class, race and gender divisions. Patterns of management, staffing, and projects undertaken attempted to reflect this concern. This chapter discusses the gender dimension of network activity. Chapter seven addresses the ways in which class relations were manifest in the work of the Network.)

PRODUCTS AND THE GENDERED DIVISION OF LABOUR

At the time of the interview there were eleven permanent workers in the Technology Network. In addition to an accountant, two clerical workers and a cleaner, there are two teams; the workshop team and the community team. In principle both the workshop team (3 men and 1 woman) and the community team (2 women and 1 man) engage in project development work with individuals and groups of local people. In practice the workload is borne overwhelmingly by the community team and the clerical workers. Of the eleven workers there are six black workers, both men and women. Jane is the Co-ordinator of the community team, she works with Janet and John. Paul is the Co-ordinator of the workshop team, he works with Sandra, Alan and George.

Community Team: Jane, Janet and John.

Workshop Team: Paul, Sandra, Alan, and George.

JANE: Gender relations shape all our work, not only the projects but also the general running of the Network. We're trying to break down the barriers - yet we have two teams, one classified as the technical, which is male dominated, and one classified as the community team, and is female dominated. And yet, when you actually look at what the two teams do, (and this is obviously biased because I'm in one of the teams) I think the two teams each do just as much technical work. In fact if you look at the whole of this Network - and in that you include the clerical workers - you find technical work all around.

When we had to run a computer course for people who wanted to set up in co-ops, it wasn't Alan [the computer man in the workshop team] that did it, it was Sandra [electronics, workshop team] and Valerie [clerical] that ran the whole course; set it up, did all the technical side of it. And if anything goes wrong with the computers, or if anything goes wrong with any of our electrical items, its always Sandra that sorts them out. When we moved to the downstairs office, we had George coming round saying "Let me put that up". Janet and I just ignored him, but John had to say to him eventually, "The community team can pick up a few nails you know". It's always that sort of simple thing, they always consider them to be men's jobs. It's not really the technical things - mending plugs, we can all do that. That's not the problem. If you look at what the workshop team does do - sorting out the photocopier is considered the technical, the

men's job, like fixing the toilet seat on or sorting the locks out. But for instance, the alarm system, we've now got alarms on all our exit doors. It was Sandra that organised all that. And right at the end Paul came along and gave alarm keys to all the men.

PL: Why are you thinking about the photocopier, the word processor, computing and mechanical things as the technical?

JANE: I'm not really, but that's how Paul and George view it, with a hardware focus. That's the whole point about the Network, people only look at the hardware. I really have tried to push it the other way and to make it the people thing. There was an example of that today. You know I have been working with Donald [a man with considerable nursing experience who has been working on a prototype for a pelvic bath]. While I was away Donald met with Sandra and Alan. I usually go to those meetings with him to give him a bit of support, although Sandra wouldn't oppress him. Donald said to me "Alan just won't listen to me. When I try to give him technical points he gets all shirty and angry as if I didn't know what I was talking about". I said "Donald, the whole idea of the Network is exactly that people should develop their own projects, give us ideas, tell us what they want and what they think, and we take them on board." The account shocked me, this has obviously been going on and we just don't realise; in that face-to-face small scale way people are being intimidated, or having control taken away by the technical men. Of course, Donald does talk a lot and you have to cope with that,

but he's enthusiastic about his project, and he should be.

PL: What worries me is the illusion, delusion, that there is something called the technical. All you've said assumes that, yet your examples are about oppressive behaviour with people. Can you tell me about a project that doesn't involve the technical men? How would the technical be enacted there?

JANE: Let me tell you about Belinda. She's a Jamaican woman with a lot of experience in dressmaking. She's not been involved with the workshop team at all. Her project is concerned with designing and producing clothes for larger women.

The technical side is taken on by her and me. We're working together on the whole project. Anything that goes wrong with her machine, we'll mend ourselves. Pattern cutting, costing, lay-out are all done by her and me. Belinda does have a lot of experience, she had a business in Jamaica - she was running it with her sister, but her sister died tragically and Belinda had a divorce, so everything went wrong for her and so she decided to leave. When she first came to the Network, we went up to her house and picked up all her equipment to install her here. We carried it all and didn't need a man's help, and we didn't ask any man for help. We carried these heavy machines, took them in and set them up at the Network. She just has a small machine now at home, which she uses in the evenings when she gets her daughter off to sleep. If anything went wrong with her machine, obviously she'd try to mend it herself, because she does have the experience of

working with machines, or if its something really drastic, she'll call in a maintenance person. The only technical contact she's had at the Network is Paul giving her a copy of the agreement to say she'd comply with the Health and Safety rules.

PL: Can you tell me a little about Sandra and John? How does a woman get on in the workshop team and a man in the community team?

JANE: The workshop team see John as an oddity. The thing about Sandra is that she is very technically competent but very unassuming about the whole thing, so she can be quiet and gentle with project people but has confidence in her own judgement to tell them when she thinks it won't work. If she's trying to explain something, she can do so without using too many technical words. We get a lot of 'phone calls for Mr Abbott, and I say "I'm sorry, its Ms Abbott" and then when they meet her and find she is black as well, its great. I think her strength comes because she knows she is technically competent, competent and confident in her abilities. Confident not only that she can draw up a circuit and then produce it, but confident in the fact that she can communicate, that she can express her ideas, and that she can actually do the other side as well. She is the only one in the workshop team who can put their ideas down on paper, she can give you a written report that is accessible.

These are selected extracts from a much longer conversation. They are included here not to 'tell it like it is'; Jane's account has been included as part of an attempt to put some particular flesh on the more general questions about the divisions of labour which contribute towards definitions of the technological. The account inevitably touches on a number of issues, the focus here however is on the ways in which the sexist relations of the workplace were sustained by a depersonalised emphasis on things. The men were in charge of the things, and things, especially engineering things, are deemed to be important. Women were occupied with the process of co-ordination and their work was given less recognition.

Jane's account confirms the ambiguity which surrounds definitions of the technical. Her definition moves between that imposed by the men in the workshop team, and a more general sense of the technical being related to machinery. Either way, 'technical' work is men's work. The distinction within the Network between the technical team and the community team further confirms the association of men's work and definitions of the technical. The introduction of the Caribbean cookshop into Network premises did much to challenge people's pre-conceived notions of technical work. The oily rag/soldering iron image of technical work has been, in part, undermined by the production of Jamaican food and by Belinda's elegant dress designs. But those projects were seen as 'soft' by most of the men working at the Network, and certainly by the Funders of the Network. Even when women, like Belinda, do develop skills in a 'soft' area, they meet discrimination.

Even when projects fall indisputably into a 'technological' area of work, it is difficult to gain recognition for the 'soft' work that necessarily accompanies the project. 'Soft' work is largely women's work. It is not defined as technical. Trying to gain recognition for that work is part of the challenge to definitions of technology, part of the attempt to chip away at the dominating myth that production consists of a string of tasks, starting with specialised conceptual work and ending with a physical product. That account makes a mockery of the real work of production, and particularly excludes the work largely undertaken by women workers at the Network, even including those women with technological training.

CONCLUSION

On one reading, feminist attempts to challenge the taken for granted definitions of technology - in science fiction and in practical technological work - may be seen as utopian in conception and ineffectual in terms of the wider society. However ill-conceived the project, or marginal the effect, these examples do appear to shed some light on sociological approaches to technology as a gendered form. Feminism, it seems, has the potential to speak about technology, to find an appropriate voice. It is revealing to note that only in science fiction have feminists given voice to a critical account of technology. Only within the feminised modalities of fiction has it been possible to treat technology not as the product of technical expertise, but as an expression of gendered relations.

The inclusion here of a personal account is consistent with a feminist stress on the validity of subjective experience. The account, although brief, does suggest some of the everyday frustration felt by a worker striving to prioritise the social over the technical - this in an environment explicitly planned to achieve precisely that. Most importantly, Jane's account hints at the symbolic dimension of work, and the way in which "the technical" is constructed in work. Her account suggests that the strong association between the technical and masculinity were being enacted in the minutiae of working relations at the Network. Yet such associative meanings are difficult to capture.

The last chapter commented on the fact that cultural studies writers have largely neglected to explore the

symbolic dimension of paid work, Jane's account suggests a rich circulation of meanings at the Network, an economy of symbolic practices linking masculinity and the technical. Yet to separate out that imagery from the imperatives of technical rationality poses significant methodological difficulties. The sociological challenge then is to find a means to describe the technical in sociological terms - terms which embrace the material and the symbolic dimension of technical knowledge and activity.

This chapter has moved from feminist social theory, through feminist science fiction to feminist practical action addressed to democratising technology. Concerns have ranged from the materiality of physical strength, through representations of technology in fiction, to the practical construction of "technology" in Thames TechNet.

In its challenges to the societal and sociological status quo, feminism has addressed both the material and symbolic constitution of the category "woman". To do this feminist writers have had to adopt a critical attitude to existing objects of knowledge, methods, modes of discourse. Challenging technological taken for granted will, it seems, require a similarly critical approach. The next chapter tries to adopt this critical attitude, it focuses chiefly on class rather than gender relations and discusses radical attempts to find a voice and set of practices to democratise technology - building upon a marxian rather than representational view of production.

CHAPTER SEVEN : TECHNOLOGY, UTILITY AND WORK - SOCIALLY USEFUL PRODUCTION

There is a set of products, processes and techniques which are conventionally defined as technology. These have received some sociological attention. The aim of this thesis is to look behind that convention; to consider technology as an expression of human work, as both material production and as a cultural form.

Marxian and culturalist accounts of work have been discussed in an attempt to understand technology by reference to work. Each offer useful insights: a formal analysis of the production and consumption of useful products; and an ethnographic approach to the symbolic and sub-cultural dimensions of human work. In Part III the form of discussion has shifted away from formal social theory and toward a more concrete consideration of the ways in which technology is constituted in work. The last chapter explored the ways in which technology is constituted within feminist social theory, feminist literature, and feminist practical projects. The emphasis of this chapter is on class rather than gender divisions.

The discussion thus far has begun to isolate some of the current inhibitors to the development of a sociology of technology: an economistic notion of work; a physicalist notion of technology as artefact; a neglect of the ways in which technology is constituted in cultural life and representation.

This chapter focuses specifically on recent attempts to engage in what has been called "socially useful production". As it happens, and happily for this thesis, attempts to produce for social usefulness have historically focused not simply on production, but on the production of technological goods and services. There are good grounds to suggest that an exploration of socially useful production initiatives may make a contribution to a sociology of technology:

Firstly, the aim of such developments is to produce for usefulness, rather than profitability, and this points to a non-economistic notion of work. Secondly socially useful production projects have tried to address the social exclusivities of technology, and have tried to explore ways of democratising access to technological design, manufacture, and consumption. Thus they represent an attempt to change the social relations of technical work and may suggest non-productivist approaches to work. Finally the projects discussed in this chapter are small scale, local, and focused, and thus are in sympathy with the emphasis on context and specificity which is evident in Marxian cultural studies, and, as we have seen, is also suggested in Marx' analysis of labour process.

Previous chapters have pointed to the separation of political economy and culturalist perspectives as they impinge on a sociological understanding of work and technology. The separation has been expressed here in terms of technology and "technology". The thesis has suggested that the separation of these modes of analysis, their unconnectedness in terms of both

theoretical perspective and object of knowledge, lies at the heart of the difficulty of generating a sociology of technology. This chapter turns to the notion of socially useful production to consider these separations from a rather more concrete perspective. The chapter has two parts. A first section considers contemporary accounts of attempts to engage in socially useful production (SUP). Given the radical thrust of SUP projects and their explicit critique of traditional modes of technological production, the aim here is to explore the extent to which such initiatives contribute to the notion of non-economistic and non-productivist modes of technical work. In particular the aim is to explore - through concrete accounts of practical work - the extent to which SUP projects offer a way, however implicitly, of combining marxian political economy with a marxian culturalism.

A second section focuses on one practical attempt to produce for usefulness. And here the account explores the extent to which changed relations of production may contribute to less exclusive modes of technical work. The aim is to show how, in a specific context, the separation of political economy and culturalism lose their analytical distinctiveness.

I SOCIALLY USEFUL PRODUCTION

The following discussion considers the concept of utility and how it might be used as a touchstone for technical production, with particular reference to popular planning as a means of organising production. An assessment of SUP initiatives takes the discussion back to the specific concern to develop a sociology of technology.

THE CONCEPT OF UTILITY

The discussion in chapter four drew attention to the centrality of context and utility in Marx' concept of labour process. It was suggested there that by a focus on these two aspects of labour process, the productivist limitations of labour process could be overcome. The following discussion considers some contemporary accounts of work, where work is shaped by the production of utility rather than surplus.

The idea of socially useful production (SUP) was fairly widespread in the early 1980s when a number of initiatives were set up with the aim of realising less exclusive forms of production.

The notion of SUP has a number of strands. It derives in part from the (Utopian) socialist concern to put usefulness before profit in production; in part from the experience gained in constructing the Lucas Aerospace Alternative Plan; and in part from a number of initiatives, undertaken by the Greater London Council (GLC) and other socialist Metropolitan

Authorities and municipal councils, geared to the implementation of alternative economic strategies.

The Lucas experience focused attention on the notion of SUP; other attempts to draw up Workers Plans, at Vickers and elsewhere, also adopted the idea in their proposals. In the early 1980s, the advent of labour controlled metropolitan authorities, with access to funds, prompted a new wave of projects geared to the aim of SUP. Within a context of high unemployment, a declining industrial base, wholesale privatisation, and cuts in public services, socialist councils sought alternative local economic strategies. Unlike the Lucas Plan, these later initiatives had a more community oriented thrust to their productive activities. Metropolitan authorities in Sheffield, Coventry, London, and elsewhere have promoted the production of socially useful products, and stimulated co-operative development, local economic strategies, and popular planning measures.

A number of those who were involved in developing these initiatives have described their work in a representative collection, Very Nice Work If You Can Get It: the socially useful production debate (Collective Design, 1985). The following discussion refers to papers in this collection.

Below three authors describe SUP in the following terms:

In the most general terms, what is being focused upon is a shift from exchange value to use value. In other words, the movement away from production

with the aim of maximising profit, towards production for social use and need. Such a view does not presume needs to be uniform. We recognise that it varies according to who you are, what you are and circumstances. (Eds, Very Nice Work,p.13)

The central feature of socially useful production is the development of ideas and organisational forms that encourage involvement, generate self confidence and release new found or rediscovered skills during the examination of how productive resources should be used to meet social needs. Initiatives promoting socially useful production must, in turn, be extremely responsible and very supportive throughout the complete process if working people are to successfully take on the tasks and challenges of responding with alternative plans. (Brian Lowe, in Very Nice Work, p.69)

SUP ... is antithetical to the central logic of capitalism and attempts to re-integrate aspects of life which capitalism has, over the centuries, managed to separate and compartmentalise. (Eds, Very Nice Work,p.201)

SUP, then, attempted to involve working class people in the processes of technological planning, design, and production. SUP, it was claimed, challenged the commodity form - the objectified relation between producer and consumer - and aimed to promote closer working links between makers and users. SUP was presented as a means of harnessing technological

processes along more democratic lines.

At the time, the many varied practical initiatives in SUP together appeared to provide a powerful challenge to the conventions of technological production and to the view that there is no alternative to market relations. Even after their demise, this innovative work does, however, pose a number of fundamental questions which are of relevance to a sociology of technology; these are discussed below.

WHAT COUNTS AS USEFUL?

Brian Lowe, from the Unit for the Development of Alternative Products (UDAP) at Coventry (Lanchester) Polytechnic, offers two examples of socially useful production.

Jean was referred to the Unit by the Coventry Co-operative Development Agency to seek help with the development of a product with which she hoped to start a small enterprise. She wanted to produce an up-to-date version of a 'haybox'. This device allows a pot of food, after being brought to the boil and placed in a box surrounded by hay (which acts as an insulator) to continue cooking slowly without the need for any additional heat. Jean thought that this technique might now be useful as an energy saving device particularly for elderly people and those on low incomes. Her idea was to replace the hay with a modern hygienic material. (Brian Lowe, Very Nice Work, p.64)

Mike...was a redundant machine tool fitter who wanted to work for himself or in a co-operative enterprise but had no firm idea about potential products....This particular idea originated from a member of the academic staff who had worked with Oxfam whilst on a short sabbatical leave investigating their transport operations. One aspect of this was the movement of very large quantities of waste rags, the low density of which meant that a lorry with a load capacity of twenty tons could only carry four tons because of its bulk. A requirement was identified for some device which could compress the rags into more compact packages and thus allow more efficient use of the transport. (Brian Lowe, Very Nice Work, p.65)

With the help of UDAP Mike developed a machine to compress rags for Oxfam. These examples illustrate some of the difficulties of defining SUP. UDAP is explicitly geared to alternative products; by what criteria may these products be judged useful? Both UDAP examples attempt to bring some technical solution to the broader problem of poverty. Both products have been produced for particular markets, and will be sold to consumers, in this case charitable organisations. It is difficult to be quite sure of their political distinction from other commodities. Association with those on low incomes and with Third World charity does not itself necessarily imply sound resource use, or forms of non-oppressive production, or closer relations between producer and consumer. Can utility inhere in the physical matter of products at all? The UDAP account exemplifies a familiar

tendency to fetishise usefulness, to see it as a property of things rather than as a relation between the producing context and the consuming one.

Several years ago I was centrally involved in setting up a Technology Network. As outlined in chapter six, the Network has worked in close liaison with a local polytechnic. The intention, like that of the other networks, has been to bring together a number of elements to engage in SUP. These elements comprised plant and expertise of the Network and of the Polytechnic (including academic, technical and research staff, together with student project work); the unused skills of redundant workers in the local area; and the many needs of individuals and groups which are unmet by conventional market forces.

At the Network we, too, noticed examples of the tendency to see design independently from the context of use: for example, a Technology Network in North London asked our electronic engineer for help in designing a small device to be worn on the chest of blind-deaf people and to vibrate when their doorbell is pushed. Our engineer was attracted to the project and worked enthusiastically on the necessary circuit design. Only when the design was well under way did he realise that opening the door does little to help the blind-deaf. They can neither see nor hear who is there; theirs may not be the technical problem of hearing the bell. The device may or may not be useful to blind-deaf people. The point is that we have no way of knowing without greater familiarity with the lives of blind-deaf people. There is nothing we can take for granted about utility.

The need is for a definition of technology that embraces not only hardware but also the series of supporting social arrangements, the patterns of people's work, that are built around the hardware. By itself technological hardware is useless, it is like a 'bargain' in a shop - no good unless it corresponds to your purposes. Drawing on Marx, I argued in chapter four that the technological product itself does not contain a fixed quantity of usefulness. Utility is realised when products are bent to productive purposes, through the incorporation of the hardware into already existing working patterns, relations and symbolic frameworks. The word processor, for example, slots very neatly into the social relations that have grown around making the typewriter useful.

Conceiving of usefulness as independent of purpose and context, is one pitfall in the elaboration of SUP. Another is the tendency to take 'usefulness' unambiguously.

In his contribution to Very Nice Work, Mike Cooley, centrally associated with the Lucas Alternative Plan and later GLEB's Director of Technology, points to "four major contradictions in industrial society which make SUP a compelling alternative":

First, there is the appalling gap which now exists between that which technology could provide for society, and that which it actually does provide. (Cooley, in Very Nice Work, p.19)

The second contradiction is the tragic wastage our society makes of its most precious asset - that is the skill, ingenuity, energy, creativity and enthusiasm of its ordinary people. (Cooley, in Very Nice Work, p.20)

The third contradiction is the myth that computerisation, automation and the use of robotic devices will automatically free human beings from soul destroying backbreaking tasks... (Cooley, in Very Nice Work, p.20)

Fourth, there is the growing hostility of society at large to science and technology as at present practised. There seems to be no understanding of the manner in which scientists and technologists are used as mere messenger boys of the multinational corporations whose sole concern is the maximisation of profits. (Cooley, in Very Nice Work, p.20)

In his account of the preparation of the Lucas Plan Cooley stressed energy saving, empowering the worker, and designing for the underprivileged as criteria for technological design. Designs for the Lucas Aerospace Alternative Plan included a heat exchanger, to combat hypothermia amongst elderly people; a seat for disabled children; and much needed renal dialysis machines. All these products touch a humanistic nerve. Yet would a heat exchanger be any less useful if it were on sale in Woolworth? Does function determine usefulness; does commodification necessarily diminish utility? Or does utility derive from the process of production and consumption? Revealingly,

none of the Lucas products has gone beyond the prototype stage, (except one product, the road-rail 'bus, which has been adopted by the British Coal as a means of reducing the labour force in mining). This hints at the difficulties of employing usefulness as a criterion for design; problems of patenting, production, and financing have dogged each of these products. It may be argued that, to some extent, the Lucas workers have treated The Plan in the same fetishised way as they have treated technological design - unrelated to the cultural intricacy of putting ideas/design into practice.

HOW CAN USEFULNESS BE EXPRESSED?

Trying to embody/design usefulness in products and processes of production is one problem. Expressing or quantifying usefulness presents a greater order of difficulty altogether. A centrally important question then, is: by what means can SUP substitute for the market relation?

The Technology Network, whose aims were outlined in chapter six, started with high ideals, to forge productive relations between producers and consumers and to address social needs for products unmet by the market mechanism. This was made possible chiefly by injections of public money. As a substitute for the price relation Network staff have drawn up rough and ready criteria for giving priority to one project over another (see Appendix II). Such arrangements are possible on a small scale; if SUP is to have applicability on a larger economic canvas then the problem of generating alternative mechanisms for

exchange will have to be addressed. The idealistic rhetoric of SUP is not enough to counter the significant material force of market relations. Such deeply entrenched mechanisms for exchange cannot be wished away; they form part not only of material exchange but also of divisions of labour, and worker subjectivity; in the present era, market relations have become deeply embedded in language and culture.

In their paper in Very Nice Work, Sheffield City Council report their experience of mounting a range of employment initiatives, "practical examples which challenge the argument that 'there is no alternative'"

They...provide models of alternative ways of organising production and use to ensure that unmet social needs are catered for outside the mechanism of the market. In the process they will provide workers and users with the experience both of what alternatives are possible, and of the organisation that is necessary to put them into practice. (from Sheffield City Council Employment Department document, in Very Nice Work, p.30)

The educational benefit for participants is clear, what is less obvious is the economic form of organisation necessary to sustain such optimistic alternatives. How are priorities ordered in the absence of price? What is the relation between exchange value and use value? and between needs and value? The authors of Very Nice Work bypass this difficulty.

The central idea of Socially Useful Production is, in its simplest formulation, that we should

collectively produce those things we need, rather than things that are frivolous, dangerous or even deadly. This is so simple, so 'obvious' an idea that it takes a conscious effort to remind ourselves that the system under which we presently produce and consume goods is predicated on quite different principles. The rationale of capitalism is the production not of commodities and services, but of profits; and the only measure of a thing's worth is its ability to generate profit. This, as we all know, means that those needs backed by purchasing power are met, while those needs for which there is no 'economic' demand go partially or totally unfulfilled. At its most grotesque this 'logic' allows for the creation of a steady supply of Cruise missiles, but for a shortfall of kidney machines. A central demand of Socially Useful Production is that we challenge the logic which underpins such decisions. (Eds, Very Nice Work, p.15)

Of course there is no compassion or morality in market relations, but that does not mean that profit entirely contradicts usefulness. Indeed profit depends upon perceived use value backed up by purchasing power. Although the authors' notion of utility does have puritanical overtones, usefulness to the consumer may have many diverse meanings. Nuclear weapons and plastic bullets, although deadly, can have utility for politicians. Apparently frivolous products are useful. "Things we need" are often both frivolous and dangerous. "Needs", like technology, are also changing and, although not entirely malleable, manipulable by both profiteers and by well-intentioned

socialists. Needs, too, are cultural products. Which forms of hi-tech medicine are 'needed' and which are 'dangerous'? How are preferences and desires to be expressed?

Debates within SUP usually refer not to desires but to 'unmet needs'. This notion does not help, because there is nothing obvious or fixed about need. In her contribution to Very Nice Work, Sonia Liff gives an illuminating illustration of the difficulty of determining need. Focusing on the food processing industry, which has largely female employees, Liff asks what forms of SUP would be liberating to women employees. Arguably desirable increases in the production of unprocessed food would mean not only more (unpaid) work for mother but also a corresponding decrease in opportunities for employment. What is of use to the wholefood enthusiast may not be of value to the female employee or to the housewife - even if they are the same person! Who determines need? Whose needs have priority?

The intention here is not to suggest that price is an adequate expression of preference, this is not an argument for Keynesian economics, for the distribution of wealth to allow preferences to be expressed through the price relation. The 'grotesqueness' of profit maximisation cannot be overturned simply by reducing it to a matter of the distribution of spending power. However, SUP, as a concrete practical alternative, must have a clear relation to the market economy with which it co-exists.

Outside the mechanism of price, what would be some ways to know people's preferences?. At the GLC and elsewhere Popular Planning Units had been set up to provide a mechanism for the democratic determination of municipal production. However, the way in which this was tackled raises another set of problems, as can be illustrated from the account given by Hilary Wainwright in Very Nice Work.

POPULAR PLANNING AND THE DEMOCRATISATION OF PRODUCTION

In generating concrete practical alternatives to Thatcherite economics, socialist councils have set up Employment and Industry Committees and developed a range of equal opportunity, co-operative development, and other employment generating policies. Popular planning has been a major strand in many of these initiatives. Popular planning represents an attempt to find an alternative to the price mechanism as a way of ordering production. However, it presents problems at a conceptual and implementation level. These concern, firstly, the extent to which it is possible to institute popular planning as an effective and culturally familiar activity. A second concern is the ways in which SUP theorists, in high status, well-paid employment, co-opt and appropriate the concerns and activities of working class community activists.

The necessity of basing socialism on popular organisations rather than relying on a central state apparatus is particularly clear as far as the economy is concerned. A socialist economic strategy must aim to transform production. Changes in distribution or in circulation do not

transform the direction or motor of the economy. For that motor is made up of the mechanisms of production, its drive consists of the way that the means of production are deployed, for what purposes and in whose interests. Only democratic control over how people's labour time is spent and how physical productive resources are allocated will change the motor of the economy from the accumulation of private profit to production for social needs. (Wainwright, Very Nice Work, p.41)

This paragraph appears to represent an analytically consistent account of production for usefulness. However, stimulating and structuring those processes of democratic control requires funding and organisation. It also means recognising the cultural context of production; since we live in privatised and individualistic times, it means finding a context within which 'popular participation' does not look culturally strange, and is accessible and credible as a way of winning something.

In her account of the People's Plan, Hilary Wainwright describes how the Newham Docklands Forum developed an alternative plan for the local economy as one means of resisting proposals for a short-take-off airport for use by city corporations.

When we talked of 'popular planning' to activists in Docklands, a glazed look came over their eyes. There had been so many well intentioned 'strategic plans', 'planning processes' and 'planning consultation', all with their own gimmicks and sweeteners. Why should the GLC's

proclamations of support for popular planning be any different? It was only when we became involved in the Campaign Against the Airport, attending the public meetings in the Three Crowns, North Woolwich, joining in the steering group discussions in Lil Hopes' front room, that 'popular planning' began to make any distinct practical sense. (Wainwright, Very Nice Work, p.45)

This sounds a practical and purposeful approach, but perhaps masks a number of difficulties. How is it possible to introduce the idea of popular planning into already existing cultural patterns? Wainwright shifts from a marxian analysis of production to a folksy account of the Docklands group. Folksy detail, however accurate, cannot substitute for the cultural silences in her conception of production. The romanticised concept of working class life in SUP literature is manifest even in the ways in which the accounts are told. Popular planning is an abstract concept, deriving from those who work in well-paid middle class jobs. It does not build upon any familiar cultural form, it is not, itself, a point of cohesion. Whilst a threatened increase in aircraft noise is a specific and immediate point of mobilisation, local interest does not necessarily mean democratic forms of participation. What forms of community organisation reach beyond 'activists'? How is it possible to give all a voice in the proceedings and in the process?

The forum had less than six months in which to prepare their alternative plan. They had never done anything like this before. The People's

Plan Centre - five workers, three part-time, two full-time - were local people with detailed knowledge of the area and the needs of particular groups but with no experience of a project quite like this. One, Tracy Hastings, was only leaving school in May, but she had strong views on the need for water sports facilities to use the docks and the river. Two, Daphne Clarke and Annette Fry, were local mothers both involved in local childcare groups and other projects such as a Toy Library, concerned with children. Bill Hart, a 53 year old ex-tugman had a deep commitment to seeing the docks used in some way for shipping and boat building. Gary Cooke, a young ex-T&GWU shop steward, was interested in projects that would exploit new technology in a socially useful way. (Wainwright, Very Nice Work, p.46)

This account, and references to 'ordinary people' in Very Nice Work by both Mike Cooley of GLEB and Paul Field of the Coventry Workshop, suggests a curiously romanticised conception of working class people. There is a strong imagery of plucky local heroes, of cloth cap idealism. We are, all of us, fairly ordinary; in Very Nice Work 'ordinary' is an odd euphemism for the unempowered or disempowered. Asking 'local people' is no sure touchstone, local people are made in ideology; they, like anyone else, find it difficult to transcend existing conceptual structures. Meeting in someone's front room does not necessarily ensure authenticity to the project, nor does it given coherence to an analysis of production that rests on an idealistic rhetoric about the desires of working class people.

Giving a particular example to illustrate a general point provides for engaging reading. Concrete detail helps to put flesh on abstract ideas. My argument is not against specificity. Wainwright's account represents a version of socialist story telling which portrays working people as an harmonious homogeneity - like socialist realism they all stand together, men and women, black and white, old and young, with no rivalry or discord. And detail appears to add legitimacy to this construction. Surely the five workers must have had somewhat conflicting priorities? And would another five people yield a different perspective on the Plan? By denying political or interpersonal conflict in their texts, socialist writers fail to deal critically with the deep cultural resistances to collective forms of planning.

At first sight the account of popular planning may seem to be unrelated to the notion of socially useful production, and in turn to a sociology of technology. Yet popular planning initiatives, sponsored by metropolitan authorities, did give some glimpse of the difficulties of democratising decision making processes. The aim of popular projects was to change relations of municipal production through the device of giving consumers a voice. Yet participation is more than an organisational matter. Giving people a voice is a cultural activity. Wainwright's account stresses the familiar ordinariness of the workers at the Popular Planning Centre, revealingly it does not address the much greater difficulty of overcoming the exclusiveness of town planning or airport design. These cultural exclusions are also a significant part of democratising technological production.

On a more practical note, participatory structures assume that working class people have the time and energy to become involved in local authority and municipal experiments. I have been on the Board of the Technology Network since its inception, and put in many weeks' work to get the project going before it even reached that legal formalisation. Involvement has been very time consuming. Which working class people could spend such large amounts of time, unless they have a job with great flexibility? Who would want to attend all those formal meetings, struggle to understand all the financial and technical language, unless that world was not entirely strange? Who would want to take on managerial problems, and associated legal responsibilities, unless they already saw something to gain from a close involvement in the project? Who could afford such interest? It is easy to underestimate the personal and economic cost of participation, costs of time, travel, telephone calls, or even of buying a round.

Producing for utility logically entails giving consumers a voice to express their desires. But constructing an open door to planning and decision-making procedures is not enough. Unless those procedures themselves are culturally and materially accessible, there is a danger of providing no more than a revolving door, of spreading disenchantment and a sense of failure among departing participants. Whilst popular planning may have a potential role in the transformation of production, there has to be a more fundamental change than another set of committees and another round of meetings for those who are already

local activists.

Attempting to involve a broader section of working class people, over a wider set of economic relations, socialist councils have sought to include unwaged workers, women, and 'community' groups in their local economic strategies. Clearly the active co-operation of local people is preferable to ever more formal structures or more centralised state intervention. However, questions of the form and content of that participation and consent have yet to be seriously addressed, still less to be incorporated into an analysis of production.

SOCIALLY USEFUL PRODUCTION: AN ASSESSMENT

In spring 1986 the Metropolitan Authorities were dismantled and, despite popular support, the activities of many Labour municipalities severely curtailed by cuts in what was then the Rate Support Grant from central government. The heyday for well resourced experiments in SUP has gone, for the time being at least. What contribution do these recent initiatives make to a sociology of technology; what do they suggest for an understanding of work, and of technology as an expression of work? What do they tell us about the possibilities for building technological usefulness? Of producing less limiting technology? What light do they shed on a cultural analysis of production?

Usefulness cannot straightforwardly be a criterion for production, for three reasons. Firstly, utility does

not provide a sufficiently subtle indication of priorities. As we have seen, SUP supporters make much of the 'grotesqueness' of profit maximisation and see an alternative in production for use. Yet, as previously argued, production for exchange depends on perceived use values, it is not the case that usefulness as such can simply replace exchange value or profitability. That is far too simple a view. Earlier discussion has argued that production is partly framed by assessments of utility - but those assessments need to have some means of expression and of ordering. The price relation provides a mechanism for ordering production priorities and for expressing preferences. Of course the social consequences of that mechanism are absurd and unequal. But there is still a necessity for some way of expressing assessments of utility and of evaluating production. Price and profit, moreover, are not only economic entities, they are also cultural phenomena; they are embodied in social practices, in language, attitude, and expectation; in legal structures and international relations; price and profit form important interpretive mechanisms for understanding the world. It is important to recognise the cultural significance of market relations: that social embeddedness cannot be dislodged solely by economic reconceptualisation or intervention. There is also a requirement to recognise and to act upon the broader sets of relations which consolidate the power of price as an expression of preference and profit as an organising criterion of production.

The second difficulty with the concept of utility as a criterion for production is its essentialist undertone, which denies that exchange value implies use value.

Obviously consumers do not buy commodities which are completely useless; the act of buying itself indicates preference and some use value. Whilst consumers are not free, they are not entirely manipulable; they do express preferences in important ways. However absurd a commodity may appear to be, its purchase by others indicates the extent to which evaluations of utility are context dependent; what is pointless to one is indispensable to another. Usefulness is culturally specific, culturally defined - a shifting and multifaceted criterion for production.

A third difficulty with employing utility as a touchstone for production, particularly technological production, is the extent to which utility may be seen to be a property of products rather than being a definition which derives from the cultural context of production and of consumption. SUP has been seen as a matter of alternative production - better design, more energy saving, products with a social conscience. But, as I have argued, utility cannot inhere solely in the product, abstracted from the productive purposes of those who will consume the product, those who will give life to its potential utility. Utility cannot be maximised by looking at the production side alone, the context and specific purposes of consumption are equally important. Popular planning initiatives are inadequate on two counts; both are related to a non-recognition of the culturalist dimensions of technological work. They do not provide an adequate bridge between the contexts and purposes of production and those of consumption; such initiatives may themselves be culturally unfamiliar to the very groups which they seek to empower. Popular planning

initiatives have proved to be unrefined measures and expressions of preferences, noisy channels of communication for the detailed requirements, the specific assessments and utilities of consumer groups. It may arguably be said that 'popular planning' itself became a reified device to effect production planning.

Popular planning initiatives have attempted to give consumers a voice outside the market relations of commodity and price. Yet it is difficult to see commodity products as unambiguously bad, and SUP products as unambiguously good. Much depends on the extent to which the producing context is sensible to the needs and purposes of those who will use the product. And the price relation is one, albeit limited, way of expressing that. Popular planning meetings, voluntary and culturally unfamiliar, do not have the ordering effect of price. Where the exclusivities of technological production and consumption is concerned, the cultural strangeness of popular planning takes on an added emphasis.

Utility is an elusive phenomenon. Building utility is not simply a technical matter, nor solely a matter of giving the community consumer a voice, nor does it necessarily accompany non-commodity production. Utility has its origins in production but takes its definition from the context of consumption.

In the marxian account, utility derives from relations within and between the labour processes where production and consumption of the product occurs. But, in order to yield any utility itself, that formulation has to be located in the cultural context of particular workplaces. The economic concepts alone

do not shed any light on how to make things useful, either as raw materials or as instruments of production. The economic concepts of production and consumption suggest a relative autonomy to these activities. In practice production and consumption, making and using - united in the labour process - are characterised by contradiction, social divisions, and power relations - just like any other social practice. In order to understand, and to maximise, technological usefulness the analysis has to go beyond economic categories to sociological concepts and to cultural maps and textures. Neither production nor consumption are simply technical or economic activities. They are in the world, they necessarily embrace a whole range of already existing human relationships - of gender, race, age, and class; of knowledge and expertise; of cultural capital and powerlessness.

SUP initiatives have grown out of socialist aims to democratise production, particularly the production of technical goods and services. These accounts of practical projects embrace a concept of work which is geared to social, rather than economic purposes. To that extent SUP accounts move closer to the marxian concept of labour process outlined in chapter four, where the processual and contextual character of labour process was emphasised. At the same time the practical aspects of these initiatives insert a cultural dimension (or at least anti-formalist) into the concept of work. These are not formal analyses of utility, the accounts represent practical attempts to implement a marxian notion of use value production outside commodity relations. The implied concept of work is one where collectivity, skill enhancement and

social use are emphasised over hierarchy, fragmentation and commodification; a mode of work relation that has been able to occur largely as a result of support from the local state. But participative relations of production do not necessarily produce useful goods and services - the quest for utility, it has been argued, must engage in already existing social structures. It is not enough to implement SUP as an alternative economic strategy, production is not simply an economic matter. **To be effective SUP must firstly address not only relations of production but also relations of consumption, and secondly must engage with the circulation of meaning as well as of value.** Unless both spheres are addressed it is difficult to see how work driven by notions of SUP can have any political or sociological purchase.

Of key importance for this thesis is the fact that SUP projects have worked to produce not only useful products, but useful technological products. This may be chiefly due to the trade union and engineering contexts within which ideas of SUP have been developed. Despite the attempt to develop changed relations of production, the concept of technology implied by these accounts has an objectivist thrust. Utility is seen to inhere in products. Here too the failure to consider relations of consumption, let alone the social exclusivities of technological consumption, means that any consideration of utility as a contextual, a cultural, matter is excluded from the account.

This section set out to explore the extent to which SUP projects could shed light upon the formation of a non-productivist, non-economistic notion of technical

production and consumption. However, the discussion suggests that despite the imaginativeness and seriousness of the activities, SUP initiatives display some of those very features which exemplify examples of marxian literature described in earlier chapters. The accounts suggest that decontextualised notions of utility, of consumers needs and preferences, and of technical products still persist. Despite the aim of SUP projects to work outside capitalist relations of production and the commodity form, a striking neglect of context, of subjectivity, of culture emerges. This is not, however, a wholly negative conclusion, for the excursion into accounts of SUP practical projects has provided a means of demonstrating the deeply embedded character of marxist productivism, most particularly as this relates to technology.

SUP projects were practical. They took place in specific contexts with real people, with real purposes. They stand in marked contrast to the theoretical formalism of some marxian labour process writers. Yet despite the immediacy of their projects, SUP activists exhibit a marked neglect of their everyday difficulties in their accounts. Instead, as we have seen, the reader is presented with compartmentalised notions of technology, class, utility, and production. Such silence points, I believe not to an oversight on behalf of the writers discussed here, but to deeply embedded features of traditional marxism - the local, the particular, the interpersonal, indeed the ambiguous are neglected in favour of categories of interpretation which see economic relations as directly determinate.

The thesis has proposed that both the material and symbolic dimensions of work and of technology be given attention within a sociology of technology. The aim of the next section is to emphasise this point by reference to a concrete example. The account points to the ways in which the subjective, interpersonal aspects of work are bound up with the economic to form the sub-culture of the technical workplace.

The example below describes a specific project within the Technology Network outlined in the previous chapter. The aim of the Network was to lessen the exclusivities associated with technical work. The network represents one attempt to bring about some small changes in the relation of production within a technological workplace. The account draws attention to the interrelated social divisions of class and technical expertise and tries to indicate some of the complex working relations within which technology is constituted. (A note on the origins of this account may be found at the end of this chapter.)

II A PRACTICAL EXAMPLE OF SOCIALLY USEFUL PRODUCTION - THE SKIP LIGHTING PROJECT

As I have described, work at the Technology Network, Thames TechNet, was ambitiously conceived. We, too, were seduced by a set of ideas and practical opportunities which had the potential of putting technical power in the hands of working class people. In obtaining funding and gaining institutional and community support, it was difficult to avoid a tone which was to some extent triumphalist. It is, in any case, difficult to work towards change, difficult to encourage, convert, and mobilise without some clear vision of improvement, some vision of opportunity and possibility.

Some members of the Network were, however, at least partially aware of the dangers of focusing too closely on the physical product as an indicator of change in productive relations. Workers at the Network were aware of some of the inequalities which surround technological work; that local working class people have little access to technology, or to the power that accompanies conventional technical knowledge and productive facilities. Network staff were sensible to some of the many exclusions of technical work - in technical talk, in the gendered division of technical labour, and in the clear hierarchies that are associated with technical expertise. Our intention was to engage in more egalitarian forms of production as it is broadly conceived and, in the process, produce goods and services which took account of the culturally specific needs of consumers.

As indicated earlier, the aim of Thames TechNet has been to develop more equal working relations in technological production. Putting those aims to work is far less easy than formulating the good intentions. Here is an account of one project:

THE NEED FOR SKIP LIGHTING

An unemployed labourer, Bob was referred to the Network from the Small Enterprise Unit of a local borough. He came to the Network with a vague idea that the lighting on building skips could be improved. Skips are waste disposal containers which are parked in the street. They are delivered and collected by lorry with a heavy lifting device. Skips, measuring about six foot by nine, are made from heavy duty steel plate.

Bob's 'vague idea' had its own history: he had been a building site labourer, a job which involved fixing warning lights on the skips each night. Bob also had a relative who had been injured in a road accident involving a skip - a fairly common occurrence in urban areas. Accidents happen when skips are unlit, cars and motor bikes drive into these heavy immovable containers; injuries from skip related accidents are often severe.

Skips are hired out to individuals or companies wanting to dispose of large quantities of rubbish or rubble. The user is required by law to light street parked skips with paraffin storm lamps, which hook over the edge of the skip. These lamps are frequently stolen, moved, or extinguished. Bob's experience enabled and motivated him to think of some solution to the skip lighting problem. He saw himself as being able to 'muck about with metal and wood', he had also worked in a foundry in the past; it was possible for him to dream of a solution. It seemed irrational to Bob that this lighting requirement had never been adequately satisfied.

Although Bob was moved by the irrationality of present skip lighting arrangements, he also saw that there might be some commercial possibility, some opportunity to make a few pounds; he was unemployed. But his clear priority was the need

for an effective lighting device. Unlike many visitors to the Network, Bob's focus was not on the subtleties of design, saw himself not as an inventor but as someone who was expressing a commonsense need.

INVESTIGATIONS

At the Network Bob talked with Jack, a member of the community team. He described his proposal for a skip lighting bracket, a bolt-on device to ensure that the skip remained lit at night. This proposal was recorded on a Project Appraisal Form for discussion and subsequent approval by the Management Committee and the Network Board of Directors; even municipally funded Networks need to make choices between competing demands. Jack also started to put together a small team of people, with appropriate skills and experience, who could work with Bob to develop his proposal.

One of the first tasks was a market survey to gather less impressionistic information on the need for better skip lighting. Marketing, the cultural studies element of micro economics, is often presumed to be a cynical and manipulative exercise. But unless the purposes and practices of potential purchasers and of consuming workplaces are examined, it is impossible to produce something useful. (By comparison, Bob's discussions with the Small Enterprise Unit had been centred around the construction of a formal business plan rather than any exploration of his perception of a social need. This accountancy-led definition of production, which, ironically, is associated with commercial realism, may explain why Enterprise Development schemes have such an appalling low success rate in setting up viable operations.)

Jack also organised other development activities: looking at the design of different models of skip; examining the difficulties of loading and unloading skips on to delivery lorries; talking to lorry drivers to determine operating difficulties. They discovered that lorry drivers work on a bonus system, they are paid by the number of deliveries and collections they are able to make in a day. It was therefore important that any lamp fixing would not delay them; any design would have to have easy and quick fixings,

and to be robust enough to be thrown about by busy lorry drivers. As a result of these enquiries, Bob and workshop staff put together some rough ideas in metal and wood and started to explore materials and production techniques, testing, for example, the breaking strain of screws.

All these activities need co-ordination, Jack and Bob were at the centre of an ever more complex network concerned with issues of marketing, designing, producing. There was, however, an unexpected intervention into their plans.

On a visit to Wood Green, Jack noticed unusual lights fixed to some skips on a building site. After some determined enquiry he discovered that a Hertfordshire welder had produced a short run of lamp brackets for one particular builder. Jack and Bob visited the welder, outlined their intentions, and were given useful engineering information about particular metals, welding techniques etc. Bob and Jack had a good relationship with the welder based on a shared white working class masculinity, they recognised that it was exceptionally good fortune to get the benefits of his experience.

PROTOTYPE

Further enquiries by staff at the Network revealed more about how skip lights are used in practice: they get stuck on the skip, they deteriorate, they get lost, lorry drivers fail to use them and so on. All this information was ploughed back into the emerging prototype. Once a fairly finished prototype had been produced, the emphasis of productive activities shifted away from need and focused more on the commercial aspects of the venture. Agreements were drawn up between Bob and the Network regarding initial funding, loans and repayment conditions, licensing, and royalties.

Promotion and securing longer term financing became matters of central importance if the project was to have any life, or was to satisfy any need. One advantage for Bob was that the skip lighting bracket had a physical expression, it seemed a 'good idea', and thus fulfilled expectations of innovation around technical products.

A number of bracket prototypes were made up in the Thames TechNet workshops. They were tried out, discussed, adapted. At the same time work went ahead to find good and reliable suppliers of nuts and bolts, and to negotiate good prices for bulk supplies. In order to involve Bob in every stage of development, he was given training in welding, although this proved difficult to organise. Workshop technicians consistently wanted to do the job for Bob, rather than helping him to help himself. Despite careful observation of safety procedures, technicians found it difficult to revise their workshop experience, difficult to share their skill. Part of becoming a technician is to be identified with an exclusive and physical technique, to be part of a male shop-floor in-group. Despite Bob's credibility as a manual worker, it proved difficult to breach the fortifications of technician socialisation, difficult to dispel the definition of Bob as a non-technical outsider - even within a project attempting to minimise expertise.

SECURING THE PROTOTYPE

One company, Dorman Smith, dominates the market in road safety equipment. They produce flashing lights, cones, and other hardware routinely used on motorways. Whilst Bob was attempting to secure supplies, and confirm prices, he contacted this company. They are the largest manufacturer of lights and the price of Bob's product would be determined by his ability to negotiate a low bulk price from Dorman Smith. During an exploratory telephone call, Dorman Smith expressed great interest in Bob's project and asked many questions to which Bob gave detailed answers. There is dated correspondence to confirm this.

The next stage involved patenting the design. A drawing and verbal description were produced and a patent attorney engaged to make these as watertight as possible. The Attorney also made a search to ensure that nothing similar had been produced and marketed.

At the same time Bob and Jack turned to promotional work. They wanted to promote the lighting bracket with a strong appeal to road safety, and so they sought endorsements from the local police and the highway department. They devised a 'technical' and lengthy form for endorsing agencies to complete. They wanted a

technical appraisal, but one that produced responses appropriate to their promotional plans.

Even whilst the bracket was under test they could promote their product with "the bracket is currently out on trial with the Metropolitan Police..." Bob and Jack researched to find statistics on skip related road accidents. These were not available - all they could find to justify their case statistically were legal records of cases where builders had been sued for negligence over unlit skips.

Bob and Jack investigated the Highway Regulations relating to skip lighting and found these to be inefficient in terms of illumination; they traced that back to the Police and the Health and Safety Executive to understand how distinctly bad regulations came to be, and to familiarise themselves with the procedures for getting their product legitimated. They also commissioned students from a Polytechnic School of Business Administration to carry out a detailed market survey among local authority and commercial consumers.

NEGOTIATING THE PROTOTYPE

Now attention turned to the practicalities of production. The bracket needs a large market to cover the costs of production equipment - welding facilities, donkey saw, etc. Bob had to make a decision between three production possibilities: he could farm out the various elements of production to different firms, one to weld, another to cut, yet another to package; or he could produce the bracket in a small industrial unit rented from the borough council together with seed corn capital and equipment from the same council. A third possibility was that Bob could obtain a licensing agreement with a large manufacturer. Bob and Jack decided to approach Dorman Smith to explore this last possibility. Before they could do this events took another turn. They discovered that Dorman Smith were now producing a skip lighting bracket. This was some three months after Bob had discussed the detail of his product with Dorman Smith. Whilst the large company held no patent on their product, they have such a commanding market position that they can exclude any other competitors by producing in large, cost-cutting numbers. Thus they have no need to protect their product through the patenting machinery.

Jack wrote an official and cool sounding letter to Dorman Smith, pointing out that a great deal of development work had gone into Bob's bracket, vaguely suggesting the idea of a licensing agreement, and slipping in, for good measure, that Bob held the patent. The Managing Director of Dorman Smith agreed to meet Jack and Bob in Liverpool. Although Bob is a confident working class man, he is quite unused to this kind of negotiation. On the train Jack briefed Bob on the line they were to take. He had checked out the law relating to patent. If, for example, Dorman Smith could prove that there had been some 'public disclosure' of their own design prior to the date when Bob's patent application was filed, then they were protected from the accusation that they had stolen the Network's design. Patent law rests largely on precedent; if Dorman Smith had taken out an advert or had designs in their drawing office dated before Bob's patent, they could claim 'public disclosure'. It was vital to discover whether Dorman Smith had 'publicly disclosed'. This information had to be obtained, surreptitiously, before they could enter any serious negotiation.

At Liverpool the Managing Director, Company Secretary, and senior members of the company turned out to meet Jack and Bob. The limousine took them to the Board Room for discussions and lunch. Bob was quite overwhelmed by the welcome and by the lavish boardroom. It was, for him, itself a reward for effort. For once people were taking him seriously. Yet, in class terms, they were also intimidating to both men.

Jack had experience of negotiation. He would have been in a stronger position without Bob. Yet a central tenet of the Network is to involve project members in all stages of production; this is no doctrinaire shibboleth, white liberals represent members of the working class in many contexts, that does not change productive relations in any way.

The Managing Director of Dorman Smith let it be known, somewhere in the conversation, that he was a member of the Health and Safety Executive. That is, he is part of the body that approves or rejects highway products.

Jack, did his best to impose a business-like approach on the dialogue. He attempted to establish some footing for discussion and negotiation. He hoped that Dorman Smith executives would see Bob as an eccentric, rather than as inexperienced. Suddenly he was interrupted by Bob, "How much would you like to offer me for the licence?" That is not the way such business negotiations are conducted. After that the conversation was not serious. There was little for Jack to salvage. Bob had broken both the tactical and cultural rules of that encounter and shown his hand, thrown away any possibility of establishing a bargaining position. He had demonstrated his unsuitability for future dealings.

Dorman Smith's bracket product cost £1 per pair. The Network bracket cost £6 per pair. The cheaper bracket was built for obsolescence, for a large replacement market. It was made of flimsy metal. Jack pointed out the superior design of Bob's bracket, its robustness, the impressive test results, and evidence that the consumer would pay for a stronger product. Dorman Smith's market superiority gave them total advantage. They could sell their own lights and bracket as one package. Jack and Bob made their way back to Liverpool station.

The two men had to decide whether it was worth setting up production in a small way. A local municipality agreed to place an order. Bob, through a friend, struck an agreement with a skip firm to hire out the bracket and light with the skip. They went to the borough council for start-up capital. The borough wanted the proposal stated in formal language with evidence of firm orders on headed notepaper. Bob's dealings had been informal and verbal. Eventually the council agreed to a loan of £2,000. Despite the formality of their requests, the borough had no way of monitoring the management of its loans.

It was unlikely that Bob would ever again have access to money like that. He turned to something he knew closely; he had many contacts in the scrap metal business. Bob seized the opportunity to get work and used the money to buy a pick-up truck to tow away abandoned cars to sell for scrap. Two thousand pounds buys only a very old pick-up truck; when the clutch broke the

council had to tow away the pick-up truck. Bob might well have succeeded if he had gone to the Council with the scrap cars business proposal in the first place.

III MAKING USEFUL THINGS - WHAT IS TO BE LEARNED?

A central aim of the Technology Network was to increase the usefulness of products by fostering more equal working relations within production and between producers and consumers. Thames TechNet was not an inventors club, not a design-led vision of social change, but an attempt to change technological working relations - by minimising exclusive expertise, valuing non-certificated experience, and making productive resources available to a wider range of people. In particular the account points to three difficulties of trying to generate changed relations of production:

Firstly the account points not to technical difficulties but to social features which are familiar ones to sociological analysis: to class and gender, to the power of specialist knowledge, and to cultural capital. Trying to build for utility has a fine moral ring about it. The accounts from around the country, discussed earlier in the papers from Very Nice Work, have an earnest innocence, a combination of marxian economics with a notion of an homogeneous and heart warming working class. By comparison the practice, the skip lighting project, undermines this lofty moral tone. The practice seems ordinary and disappointing after the hopeful rhetoric of SUP. Curiously, the SUP writers quoted here must all, at some time, have had close knowledge of the texture and difficulties of local production for utility. Yet revealingly I am unable to find other examples of failure in the literature; this absence reflects the triumphalist tone of the SUP debate, which does little to help practitioners. What processes have contributed to the

neglect of these difficulties in the literature? What has generated the apparent mood of self congratulation that surrounds SUP accounts? Compared to the abstractions of economics and social science, SUP initiatives do seem like a breath of fresh and realistic air. Yet their appeal derives perhaps from a rather romantic view of the working class, a view which limits the capacity to pose an effective challenge the present realities of productive work. For all their appeal, SUP initiatives remain economistic. In any specific project, SUP needs to be less concerned with technical innovation as such than with trying to change and co-ordinate a whole range of social features of production. Such a concern needs a theoretical underpinning, a theory that enables practitioners to see how the strands of changed working relations might be brought together, and most particularly a theory which addresses the cultural constitution, and social exclusions, of technology.

Secondly the skip lighting project illustrates the extent to which any attempt to democratise technological working relations must also embrace a strategy for working within and challenging existing power relations. In many respects the elements of the skip lighting project is similar to that of any other enterprise development, and to those of traditional venture capital organisations like Prutech and 3i. Those similarities are important. Any attempt at SUP has to take place within already existing social relations, of production and of consumption, but also of gender, race, and class. Production and consumption consist of these social divisions. However radical the project, however clear the

theoretical analysis, however generous the funding, projects have to take place within what is. All members of Thames TechNet brought with them class-based experience as men, women, black, white, technically competent or inexperienced individuals. In order to build for usefulness they had to engage with a world of competitive individualism; it was important to recognise at the outset, the necessity for non-Utopian theoretical formulations of SUP.

Thirdly the skip lighting project points to the value of specific details in attempting to get a sociological purchase on technical work. At one level the details of the skip lighting project are unimportant. One small attempt at SUP, an unsuccessful one at that. The rather exhausting detail of the skip lighting project is included here to support an argument for specificity. It may be argued that only through a focus on a particular set of circumstances is it possible to step outside the narrowing straitjacket of economic or technical categories. Only by referring to the integration of events is it possible to realise the complexity of the project to increase the usefulness of things. SUP concerns not only an economic analysis of production and consumption but also, as the skip story demonstrates, a number of other sociological features:

THE EXCLUSIVENESS OF TECHNICAL WORK

Technical work presents many exclusions; the workshop culture is available to a minority of men and a handful of women. A larger group of men gain some practical confidence from unpaid work. Jack and Bob have such confidence, that gave them the ability to start out on

the project at all. They are white working class men with a sharp intellect and great expressivity. Jack also has very good academic qualifications. Bob and Jack had two further strengths: firstly they had the Thames TechNet context, specifically geared to minimising technical exclusiveness; secondly they had a clear sense of the usefulness of their product - people do sustain severe injuries in skip related road accidents.

Bob and Jack were able to use their working class maleness to talk with lorry drivers, to ask around on building sites, and to get engineering information from the small welder. Yet despite these advantages they were unable to gain credibility among the workshop technicians; it was an uphill task for them to retain active involvement in the welding side of the project. The ideology of 'the technical' helped in presenting and getting support for the product as 'a good idea' but hindered the project with respect to egalitarian working relations.

CLASS RELATIONS

If increased usefulness comes from more equal relations of production, then it is important to recognise the high personal cost this carries for those involved in those reformed working relations. It may appear, to the participants, that every aspect of working life has to be reviewed, scrutinised, discussed in the light of oppositional criteria. Bob and Jack were attempting to be successful entrepreneurs at a time when small business foreclosures were at an all time high and, at the same time trying to develop non-hierarchical forms of technical, administrative, and promotional work.

Jack used an impressively wide range of skills to keep all the elements of the project active and coherent. Few enterprises, socialist or otherwise, have the benefit of that kind of subjective and institutional support. Yet neither Bob nor Jack had the cultural capital, nor the contacts, to find an easy way through the maze of business start-up for technological production. Even though they had access to financial, legal, and technical resources through the Network, even though they had the active support of local Labour controlled councils, this was not enough to prevail in the class conflict of the Dorman Smith encounter.

This raises a broader point: recent SUP initiatives were borne out of trade union activity and driven by labour controlled councils, by those whose chief concern is resisting the domination of class relations. Recruitment of personnel to develop the projects has largely favoured "working class people". But the analytical category class does not adequately define the cultural variety of actual participants. Class is a category in political economy, actual people have a cultural existence. Working class people are heterogenous - politically, subjectively, culturally. Not as SUP writers would want them to be, but people of the world.

Although members of marginalised groups are no doubt familiar with the struggle of daily life, that does not necessarily give them the opportunity to appreciate the struggles of other groups. Nor does it make an attempt at new relations of production any easier. SUP projects not only recruit underprivileged people, but expect them to have a clear analysis of their

situation, and to work within non-traditional modes of production, and to do so successfully in a competitive world. Utopian notions of SUP do not even confront this difficulty, let alone propose or develop a practical strategy.

Social divisions find powerful expression in the minutiae of everyday life. If these cultural features of work are not incorporated into the SUP debate, project members are burdened with unrealistically optimistic objectives, and blame themselves when failure inevitably occurs. A wider understanding of the cultural features of technological production cannot occur whilst utility is seen to be a feature of design, of products, or of the consumer politics of popular planning. The skip lighting project is a laborious tale, yet without this detail it would be impossible to develop a perspective on the cultural elements involved in the production of technological usefulness.

CONCLUSION

This chapter has discussed recent attempts to engage in socially useful production. Evoking utility as an organising criteria of production, these attempts represent a move away from an economic notion of work. Yet - it has been argued here - as currently conceived utility provides an ambiguous touchstone for the organisation of work. These attempts have been flawed not only by an objectivist notion of utility, but also by a concept of work which does not adequately take account of the cultural context within which work occurs.

The SUP projects discussed here do, however, shed some light on work in contemporary society. Against a labour process literature which characterises work as exploitative and de-humanising, the accounts of SUP point to the vitality of working people and the ingenuity which SUP project members bring to their work. The account suggests that even within capitalist society, even within technical workplaces, work retains the potential for transformative activity.

SUP initiatives have focused largely on the production of technological goods and services. How far can practical attempts at the socially useful production contribute to the sociology of technology? To what extent does work in SUP highlight the ways in which technology is constituted in both its material and symbolic forms? The skip lighting project and the other projects discussed here give some concrete purchase on the material difficulties encountered in attempts to work within changed relations of

production; they point to the difficulties of giving expression to consumer needs; they point to the ways in which technology is constituted at an interpersonal level; they point to the limitations of an economic conception of work. At the cultural level, the skip lighting tale also gives some glimpse into the ways in which the exclusions, the legitimations and the power accruing to the technical are produced and sustained in the experience of work - even in a workplace specifically developed to overcome the domination of technical expertise.

Trying to produce for social usefulness requires close attention to social divisions, here the focus has been on relations of class and expertise. This the Technology Network set out to do. But these relations are not simply economic, they find expression in the cultural, in the everyday life of the workplace. So far as a sociology of technology is concerned, the above account points to the necessity for both economic and cultural perspectives on social divisions. The discussion of Marx' account of labour process in chapter four drew attention to the centrality of human labour, of context, and of utility. These are important strands in understanding the sociology of artefacts. They form the theoretic backdrop for the account of the Skip Lighting Project. However, the lighting project also points to the need to recognise the cultural character of each of these elements. A cultural and a material perspective on human labour, context, and utility is necessary for a sociology of technology.

NOTE ON THE ORIGINS OF THE ACCOUNT OF THE SKIP LIGHTING
PROJECT:

The details of this account were gathered from participant reports and from my own involvement with the Network. Jack's testimony and Bob's testimony were taken by taped interview and transcribed. The abbreviated account given here was given to Jack who checked it for accuracy. I was a founder member of the Technology Network Board of Directors, and was in close contact with the development of a number of projects over an extended period.

CHAPTER EIGHT : CONCLUSION

The project of this thesis derived from the observation that technology is a relatively untheorised topic within sociology. The view taken here has been that this is no simple oversight, but that sociological accounts of technology themselves inhibit more critical analysis of the topic. Further to this, the thesis has set out to show that it is possible to develop a sociological account of technology by reference to a re-conceptualised notion of work.

The thesis has chiefly been concerned to explore work and technology through two theoretical traditions: the political economy of marxian labour process analysis; and an embryonic marxian culturalist perspective. The focus of discussion has been a search for elements which can contribute to a more adequate sociological account of technology.

Technology has proved a difficult topic for sociological discussion. Yet in the process of exploration a broader question for social theory has emerged: the deep divisions which characterise Marxian political economy and Marxian cultural studies, divisions which are apparent at the level of theory, but which are also evident in the objects of knowledge. The force of these divisions is particularly striking in discussions concerning a sociology of technology.

This concluding chapter tries to locate the theoretical debate about technology within the context of this broader concern with social theory.

The next section summarises the discussion of the foregoing chapters. As we have seen, this attempt to outline a sociology of technology touches upon fundamental discontinuities in sociological perspectives and sociological objects of knowledge. A second section considers this wider range of concerns together with the limitations they suggest for a sociology of technology, and sets out the elements of a sociology of technology. A third and concluding section looks beyond the heavily defined parameters of marxian labour process theory and cultural studies analyses to consider approaches which at least attempt some kind of parallelism between the two separate modes of analysis, and at best propose a means of transcending economic and cultural divisions.

I SUMMARY

The thesis started by drawing attention to a commonplace world where technology is an interesting if contradictory phenomenon: present and powerful in many spheres of social life; yet apparently surrounded by exclusivity, marked by highly defined divisions of labour and expertise. Those characteristics make technology a sociologically intriguing phenomenon. Yet, it has been argued here, sociological analysis largely assumes rather than explores these characteristics; and largely adopts a taken for granted view of technology. This view, grounded in a productivist conception of social change, assumes that technology is associated with the hardware and processes of paid production, and thus more closely identified with men's work. It has been argued here that productivist accounts are theoretically inadequate: Firstly because they posit a descriptive rather than an analytic separation between production and consumption. It has been argued here that an analytical distinction is theoretically useful since such an approach emphasises differing perspectives on work, rather than different kinds of work.

Secondly, productivist accounts ignore vast areas of human work which, although not directly concerned with the physical artefact, do contribute to the constitution of technology. The view taken in this thesis shifts the theoretical emphasis away from production. The thesis has argued that an emphasis solely on production diverts critical attention away from the many unpaid, reproductive, and representational areas of social life. Productivism

emphasises paid production and physical artefacts, and is neglectful of the cultural context of production and consumption. A sociology of technology must move beyond a productivist focus: productivism does not simply give an incomplete account, it is erroneous.

Thus the argument here has presented the view that the way in which the category "technology" is constructed in sociological literature precludes the possibility of developing an elaborated conception of a sociology of technology.

There is, of course, an already existing sociology of technology. Some of the major texts have been discussed in this thesis, most particularly in chapter two. The McKenzie and Wajcman volume, for example, points to a range of constitutive social features which shape technology. But, it has been argued here, such approaches exclude a whole range of human work by their neglect of the cultural constitution of the category "technology". The argument here has not sought to minimise the significance of those shaping factors identified by contributors to the two collections, edited by McKenzie and Wajcman and Pinch and Bijker discussed earlier. Importantly however the thesis has not sought to argue that to pay attention to the cultural dimension is simply a matter of accretion, of adding another variable or another set of considerations. Indeed the marxian culturalist approach outlined in chapter five suggests that the supposed shapers of technology are themselves shaped by the cultural context. The parallel emphasis here, on labour process and on culturalism, proposes that the shaping of technology occurs within the dual modes of

circulation, economic and cultural. The thesis has avoided any suggestion that these modes are descriptive entities. The modes of circulation are seen to be analytical tools, the production of artefacts and imagery are seen to occur across many work places. The thesis has proposed, for example, that technical workplaces themselves contribute to representations of technology as exclusive.

The main thrust of this thesis then has been to attempt to move away from the conventional view of technology which is reproduced in sociological literature. In an attempt to display the sociological character of the products and processes associated with technology, this thesis has proposed an exploration of the human work of producing and consuming technology. That is to say, to look at technology as an expression of human work.

It has been argued that marxian labour process accounts of work, and of work with technological means of production, provide a formal means of analyzing the social character of artefacts, including technological artefacts. However, as we have seen, the concepts of technology, and of work, that appear in both Marx and in more recent labour process literature also have a profoundly productivist emphasis. One consequence of that emphasis has been that the taken for granted view of technology is re-inserted into the analysis - with its exclusiveness, divisions of labour, and relations of expertise intact. The project here is not to deny that, by and large, technology is produced and consumed in paid workplaces, but rather to argue that the sociological analysis of that phenomenon cannot be confined either to those workplaces or to a mode of

analysis which gives theoretical priority to the material relations of paid work. It has been argued here that a theoretical focus on artefacts and on employment will not yield an adequate sociology of technology, that more embracing conceptions of work and of technology are required.

The development of a sociology of technology then, is inhibited by a two-fold problem:

the need to elaborate a view of technology which is not confined to the products and processes of paid production; the need to elaborate a view of work which is not confined to employment.

So far as an elaborated view of technology is concerned, the discussion has distinguished between two concepts: Firstly, the concept of what may be called technology-as-material-relation. This refers, for example, to the industrial artefacts and processes which are conventionally seen as technology, and which have been explored by labour process writers as a significant strand in relations between labour and capital.

Secondly, the concept of what may be called technology-as-symbolic-category. Here technology is seen not simply as products, knowledge, and technique but as a social category, a category of interpretation, a category of the meanings, values, imagery and cultural resonance which together define "technology".

In summary, technology, in common with all other social phenomena, has both a material and a symbolic

existence. Technology may then be analysed from the perspective of political economy, as labour process literature has demonstrated; and, in principle, the production and consumption of technology may also be explored from a culturalist perspective. It has been acknowledged here that, to date, technology has barely featured in Marxian cultural studies literature. The topic has yet to be developed in two respects: Firstly, Marxian cultural studies writers have largely neglected technology, in other words they have not explored the ways in which "technology" is produced in representation; Secondly cultural studies writers have offered no acknowledgement that conventional, shop floor, paid, technical work may be explored for its symbolic as well as its material import.

So far as an elaborated concept of work is concerned, similar arguments pertain. Work, too, it has been argued, has both a material and symbolic dimension. Work too may be viewed in terms of political economy and in terms of cultural practices. Work concerned with the production and consumption of technology may be both material and representational. Thus the representational dimension is not to be seen to be confined to the production of imagery, the shop floor is equally effective in symbolic production. In seeking out the ways in which technology is constituted in work, attention then must be given not only to physical or even material production and consumption of products and processes, but also to the representational production and consumption of "technology" the social category. And in principle the representational applies as much to the shop floor as to the film studio. The culturalist perspective

suggests that work may be associated not with wages and surplus value, but with the interpretive, the subjective, and the sub-cultural and meaning-laden aspects of life. Whilst cultural studies texts have rarely addressed employment, as we have seen a few Marxian texts in this tradition do give a glimpse of paid and unpaid work as the production and consumption of cultural life.

By this route the discussion has turned away from a productivist emphases in the concepts of technology and of work, and toward two broader perspectives. The first of these has been a re-interpretation of Marx' account of work and technology in labour process, an interpretation which emphasises utility and context and consumption. The second major concern has been the representational emphasis of technology and of work to be found in the Marxian culturalist perspective. The modest aim in the latter has been to begin to explore the extent to which the relatively new culturalist discourse could contribute to the exploration of the symbolic dimension of work, and thus of technology. Marxian cultural studies literature does not explicitly address employment, yet it does offer a slant on work as the production and consumption of meaning. As we have seen, the culturalist view of work de-emphasises productivism and economism, it embraces a broader range of paid and unpaid activity, and thus allows a broader notion of workplace.

The focus throughout has been on the ways in which technology (and "technology") has been constructed in work (whether this is paid or unpaid human activity).

The focus of the thesis is not an attempt to embrace

all human work, nor to generate a broadly based notion of work and workplaces, but to look particularly in technical workplaces. Brief accounts of work in technical workplaces have been offered. The particular question then is: How is technology constituted, materially and symbolically, in these contexts? And behind this question lies a more fundamental one: What sociological tools of analysis are available to lay bare these constitutive process? How is it possible to bring together those twin elements of sociological analysis - representation and political economy - which appear to be so diverse in both their conceptual approach and their object of knowledge?

These threads were taken up on Part III, which continued the debate with more concreteness. Firstly, with regard to gender differences, the discussion explored the ways in which technology is constituted in feminist social theory, feminist science fiction, and in workplaces. The discussion considered what feminist sociology has to offer a sociology of technology and briefly tried to suggest how the interconnections of gender divisions and "technology" are produced and sustained in one technical workplace.

Secondly, with regard to class divisions, the discussion considered how technology is constituted in a set of practical initiatives which have explicitly attempted to confront the relation between technical expertise and class divisions. The discussion considered what the "socially useful production" debate has to offer a sociology of technology and tried to suggest how the interconnections of class divisions and

"technology" are produced and sustained in one technical workplace.

Chapters six and seven have offered concrete accounts of work in a Technology Network. These accounts are set against previous discussion of labour process and culturalist perspectives which, though they have common Marxian roots, nevertheless focused upon distinctively different issues. Like other Socially Useful Production initiatives, the Technology Network had its roots in a labour process Marxism. Yet, as the accounts show, any specific exploration of Network activity reaches beyond the concerns of an economistic labour process Marxism towards a more culturalist evaluation. Attempts to build more equal relations of technological production, and to build utility, are inevitably cultural practices. Socially Useful Production is a cultural practice in two respects: Firstly because such projects take place within existing relations, and these are not simply economic but touch upon people's preferences, political experience, social divisions, and orientations to the technical. The second respect in which Socially Useful Production is as much a cultural as an economic practice is that building for utility is a cultural evaluation.

The concrete examples offered in chapters six and seven are not attempting to provide empirical support for previous theoretical analysis. The attempt here has been rather to use concrete accounts as another way of developing theory, particularly to discuss the integral character of the economic and the culturalist dimensions of technical work. Concrete accounts have

been used as a way of showing how technology is constituted in everyday practice. The accounts here suggest how difficult it is to separate labour process and culturalist issues - even though labour process and culturalist theoretical perspectives remain distinct and partial.

II DEVELOPING A SOCIOLOGY OF TECHNOLOGY: BROADER THEORETICAL CONCERNS AND LIMITATIONS

The hardware of technology appears at first to be a relatively simple object for analysis - fixed in physical form, with a narrowly defined function, usually located in predictable contexts. Yet as the discussion has proceeded, the matrix of concerns has gathered complexity:

Discussion has moved from commonsense notions of artefact, to the specialised subset of technology; and similarly from a commonsense notion of technology as object, to the human work of producing and consuming technology.

Discussion has also highlighted an elaborated view of work. Where industrial sociology has largely interpreted Marx' concepts in a relatively narrow way, this thesis has explored the broader view of labour process to be found in Marx' work. The thesis has offered a re-interpretation of Marx' concept of labour process to emphasise purpose, context, utility, and the distinction between past and present labour.

This thesis turned, too, to a culturalist perspective to amplify the labour process view of work. The culturalist view of work is largely concerned with the circulation of meaning and of cultural forms. And although cultural studies have tended to focus on a notion of culture which separates it from production and employment, nevertheless, it has been argued here, it may be equally possible to consider both paid and unpaid work from a culturalist perspective. The

discussion then has proposed a view of work which is concerned not only with producing objects but also with the production of categories.

The emergent outline of a sociology of technology has attempted to embrace a number of hitherto disparate theoretical perspectives on work and on technology. Specifically, the thesis has attempted to focus, firstly, on a materialist view of work where technological products and processes are produced and consumed, as well as a representational view of work where technology is produced and consumed as a symbolic category.

Secondly, the thesis has explored a labour process perspective on technology, on the technology of production as a significant shaper of the relations of paid production. In addition, the thesis has proposed a culturalist perspective on the processes of production and consumption of technology as sources of personal meaning and social identity.

Thirdly, the thesis tries to retain some theoretical purchase on a marxian view of work which sees change in the relations of production as a grand historical theme, and a cultural studies view of work which emphasises locality, community, and particularity.

Embracing these polarities represents the central concern of this thesis, and this attempt to understand how technology is constituted as a constellation of social phenomena. From the above summary some elements of a sociology of technology are discernable.

Like other social phenomena, technology is multi-faceted and may be explored sociologically from several perspectives. In order to resist objectivist conceptions of technology, and to emphasise its social and dynamic character, the thesis has focused upon technology as an expression of human work.

Within this focus on work, the thesis has distinguished between the sociological analysis of artefacts, and of technology as a subset of artefacts; and of "technology" as an interpretive category. These two aspects are discussed in the following sections.

THE SOCIOLOGY OF ARTEFACTS

The thesis has commented, particularly in chapter two, upon the diversity of sociological approaches to the topic technology. Yet, despite the very different traditions in which one can find technology referred to, in one way or another, within sociology - there is a common element. The unifying feature is that the concept of technology which occurs most commonly within sociology is one which associates technology with hardware.

The thesis has pointed to the theoretical dissimilarity of sociological approaches to technology, yet in the midst of this diversity technology as hardware occurs as a residual category which unites the variety of theoretical approaches and their associated objects of knowledge. In the form that technology is found in sociology, the focus on hardware is limiting, yet hardware also provides an important strand for a sociology of technology. Hardware, artefacts, are physical entities. And physicality presents

theoretical complexities for the development of a sociology of technology. The theoretical challenge is to acknowledge the physical and material existence of hardware, yet at the same time to resist the resonance of fixity and rigidity that physicality carries. The thesis argues that Marx offers some contribution to this theoretical challenge.

The marxian account of the human labour process offers a sociological analysis of artefacts, and of the work of producing and consuming artefacts. In doing so it provides a way of recognising the common origins of products and producers/consumers through the concepts of dead and living labour. In addition, the Marxian account offers a way of revealing the significance of context and utility in the constitution of products through the concepts of value and use value.

It has been argued here that Marx' account implies contextual definitions of utility. Yet it is important to acknowledge here that whilst the emphasis on context and specificity appears to be clearly stated in the Marxian text - this aspect has not been developed by Marxian writers. In the Marxian tradition these notions have disappeared. Similarly Marx' account implies the persistence and continuity of the human labour process under capitalist relations of production. That is to say, that the human labour process reveals itself in different historical forms. It has been argued here that by emphasising the continuities of the human labour process under capitalist relations of production, the marxian account may be seen to draw attention to the ways in which purpose shapes the artefact. In this way Marx'

analysis makes a further contribution to a sociology of artefacts.

Thus the marxian analysis of the human labour process provides the tools for a sociological exploration of apparently asocial hardware. The account draws attention to the significance of the purposes of production and consumption, to contextual definitions of utility, and to the rigidities and dynamism of dead and living labour. In doing so Marx offers the potential for a sociological account of the apparent facticities of physical artefacts.

By means of these analytical elements the social constitution of artefacts may be, at least partially, understood. In moving from the general notion of artefact to the subset technology Marx' account directs attention to three further elements; each has the potential to provide a counter to objectified views of technology:

The first of these elements is the concept of fetishism. In his general account of capitalist relations of production, Marx describes fetishism as the process by which artefacts take on an identity of their own, a process within which human labour becomes invisible. This approach offers an insight into the mysterious and powerful integrity of commodities, and has a particular relevance to an exploration of technological artefacts and commodities. Sharp divisions of technical labour and hierarchical relations of expertise combine to make the origins of technological artefacts especially obscure.

"Automation", for example, may be seen to represent a

fetishised view of technology, where utility becomes associated with the product rather than with the social relations of production and consumption.

The second element which is evident in the Marxian account is the notion that dead labour is dependent upon living labour to release its value. In the reading of Marx given here, purposeful labour in an appropriate context is required to realise the stored up human labour, the utility, in the artefact. For a sociology of technology this emphasis stands in contrast to the claims, from both the political left and right, for the capabilities of, for example, flexible manufacturing systems. Placing centrality on living labour reverses the thrust of much contemporary comment on manufacturing and military systems.

(Writing from a trade union perspective, John Mathews (1988) shows how the politics of production may be reshaped by a recognition of the continued necessity for purposeful human labour.)

The third element which is implicit in Marx' analysis again refers to a notion of artefacts as limited rather than super-human. It has been argued here that Marx presents a view of artefact as objectified value, as rigidly embodying conceptions of future use. Yet, clearly, prescriptions of utility cannot take full account of the variability of use, and thus artefacts inevitably display fixity and limitation in the context of consumption. In the context of use the embedded limitations of artefacts is all too apparent, as are the accommodations which are necessary for the effective consumption of dead labour. In context the many tensions between the fixity of dead labour, the

presumption of utility embodied in design, and the negotiability of social arrangements in consumption become visible for sociological analysis.

Thus, against a popular, awe-filled conception of technology, especially of new technology, as intelligent, flexible, and productive, the Marxian view stresses the central role of human labour. These are significant elements for a sociology of artefacts.

Marx' analysis then provides a sociological counter to popular and sociological celebratory accounts of new technology. In the Marxian account artefacts are bivalent: in appropriate contexts they display work-enhancing strengths, and they simultaneously display limitation and rigidity. Both these characteristics can be seen to derive from the human origins of artefacts.

Implicit in Marx is a further contribution to a sociology of artefacts, this concerns the concreteness of analysis. By focusing on contextual definition - of tools, raw materials, products, and of utility - Marx' analysis opens the way for a more ethnographic dimension to the study of technology. Marx' analysis stresses the transitivity of elements. What is raw material in one labour process is the product of another, definitions of utility are similarly context specific. A Marxian exploration of artefacts, then, requires attention to particular workplaces to uncover the transformation of value from human labour power to dead labour to utility. This aspect of the human labour process, undeveloped in Marx' elaboration of the capitalist labour process, suggests that the concept of

labour process can only make sense when applied to specific workplaces.

It has been argued here that Marx' account of labour process has much to offer a sociology of artefacts. The Marxian concept has a number of apparent possibilities, yet strikingly these have not been developed within the tradition of Marxian sociology. The transitivity of elements, for example, and the associated emphasis on context have rarely been an issue - a neglect which speaks of the timid development of technology as a theme in social theory.

Marxian labour process analysis has the potential to offer insightful ways of exploring artefacts as social phenomena, yet technology is more than artefacts, more even than the account of artefacts-in-context implicit in the marxian account. Technology itself forms a significant category, and an important prerequisite for a sociology of technology will be the willingness to recognise this distinction, and thus from the outset to problematise technology.

TECHNOLOGY AS ARTEFACT:

Technology is not simply another set of artefacts (and their attendant techniques and specialist knowledges), but a set of artefacts, which, through the category "technology", carries a powerfully legitimating force.

Through the course of the thesis a number of social processes have been discussed which may contribute to the social constitution of the products and processes of technology. Technology may be shaped by capitalist

relationships of production, by the diverse needs of consuming groups, and by wider relations of class and gender. This is by no means an exhaustive list, nor should the shaping influences on technology be seen independently. The work of Noble points to the range of subtle interrelationships which go towards the constitution of technological products and processes. And with a different emphasis, Cockburn outlines some of the means by which the masculinity of technical workplaces cuts across other factors which contribute to the shaping of technological products and processes. The point here is not to identify key sites which shape technology, but to suggest the variety and interrelationship of social processes which may play a part in framing those forms of past and present labour which become defined as technology.

The development of forces of production plays a central part in Marx' analysis of capitalist relations of production. Increases in productivity associated with capitalism are seen to rest upon the focused development and deployment of machinery, techniques and specialist knowledge. Yet a Marxian labour process analysis does not offer a complete account of why technology, as a particular subset of artefacts and associated practices should be seen as special, should be surrounded by such legitimation, should be associated with such powerful ideological forces as modernity and progress. Marx' account stresses the economic importance of forces of production but the legitimacy of technology is also a cultural phenomenon.

The concept of labour process, with its materialist emphasis, cannot shed light on the constitution of the

category "technology". Yet this category forms an important strand in the social constitution of technology.

The thesis has made a distinction between technology and "technology". A sociology of technology will need to explore the social constitution of the power and legitimacy of technology: will need to recognise both the strengths and limitations of materialist analysis of technology, and will need to explore the symbolic constitution of the category "technology".

"TECHNOLOGY" AS AN INTERPRETIVE CATEGORY

A sociological exploration of the constitution of "technology" as a symbolic and interpretive category has the potential to range over many aspects of social life. A sociology of technology will have to recognise the vast variety of sites where technology is constituted. The analysis of representations of technology can occur, for example, in film or television or advertising copy. And whilst this area of enquiry has not been pursued here, nevertheless such analyses of text could usefully form a rich contribution to the sociological understanding of technology. An analysis of language use could form another area for enquiry, as could an exploration of domestic divisions of labour in relation to technology. The potential areas for enquiry are very wide indeed. A sociology of technology must then recognise that any enquiry into the work of representation, into the constitution of symbolic categories cannot be exhaustive, can only explore aspects of highly interrelated sets of representations.

Discussion in this thesis has pointed to the ways in which the constitution of technology may be seen in sociological literature, in feminist literature, in journalistic commentary on new technology, and in the literature and practice of socially useful production. The discussion has also pointed to the ways in which the constitution of "technology" may be seen to occur in the social encounters of the technical workplace. The proposal is that a culturalist perspective on technical work will yield important elements in the constitution of "technology". Although the methodological means for such an exploration have yet to be fully developed, the production of meaning within working practice, potentially reveals the way technical workplaces constitute "technology" within relations of gender, class, and expertise. A constitution which can include the heavily policed boundaries of specialist knowledge and technique.

In both sociology and in popular commentary technology is associated with the apparent fixity and givenness of physical artefacts, a rigidity given added reality by the association of technology with expertise and the exclusivities of technical knowledge. It has been proposed here that the apparent rigidities of technological products and processes may be undermined by reference to the concept of human work. The concept of work has been offered as one way to gain some theoretical purchase on the phenomenon of technology. As we have seen Marxian accounts - both from industrial sociology and from culturalist perspectives - do offer some insights on the social character of technological products and processes. The notion of dead or objectified human labour has

considerable force. An analytic emphasis on work provides one means of seeing technology as other than fetishised artefacts. Yet, it has been argued here, work is more than material activity. Work too may be seen from the cultural perspective of the circulation of meaning and the constitution of subjectivity.

Work, however, is a slippery concept. In the Marxian account work is both subjectively and materially transformative. For Marxian cultural studies writers the production of symbolic meaning and of economic value is analytically separate. The cultural studies approach to work focuses on the circulation of cultural products, and on the use of existing cultural elements. The culturalist perspective on work minimises the givenness of the artefact, and calls attention to the social processes which give life to the product. The culturalist perspective also emphasise the work of consumption, not of artefacts but of 'texts', or symbolic and representational entities. This emphasis moves the focus of attention away from work as a physical act and toward a notion of work which is more concerned with interpretation and the construction of categories of understanding.

So far as the concept of work is concerned, the Marxian culturalist writers explored in this thesis have made an indirect contribution to a sociology of technology.

They have pointed to the notion of consumption as work, and to the interrelatedness of work - for example that the work of production is also the work of consumption. Marxian culturalist writers have drawn attention to the connectedness of the economic and the subjective, for

example of the production of image with the consumption of goods and services (Winship). The marxian culturalist tradition has also pointed to the dissonance between public and private evaluations of work, for example a notion of work which is at once objectively meaningless but imbued with subjective meanings (Willis). In cultural studies there may also be found a non-economistic notion of class in work, a notion of work that is concerned with the production of the subject, and a theoretical approach which does not simply reduce class to managerial intention (Willis and Williams). In particular, the culturalist tradition suggests a duality to the consumption of technology, for example to distinctively different modes of analysis for the technological artefact and the transmitted text (Morley and Silverstone).

So far this chapter has provided a summary of the discussion in the thesis, and has drawn out the implications of that discussion for a sociology of technology. There are, however, some limitations to this approach; these qualifications form the next section.

LIMITING FEATURES OF THE PROPOSED SOCIOLOGY OF TECHNOLOGY

There are no ready made sociological tools of analysis which coherently combine the representations of technology, with the economic shaping of technology, with an ethnography of the relations of class, gender and expertise in technical workplaces. This is precisely the theoretical context for this thesis.

1. The thesis has tried to present the view that a sociology of technology must embrace both economic and symbolic aspects of human work. Yet there appears to be a nagging looseness about this proposal; conjoining hitherto diverse modes of analysis holds dangers. It is not the intention here to suggest that there is an independent social entity, technology, which is then available for theoretical discussion by differing schools of economic and culturalist thought. Rather to suggest that different modes of analysis constitute different objects of knowledge. As presently constituted there can be no easy reconciliation or merger between these two modes of thought, for a sociology of technology this may be, for the moment, an inescapable problem. The argument here has been that, as an expression of human labour, technology is those two spheres operating at the same time.

2. A second area of limitation in the argument that has been presented concerns the extent to which theories and concepts have been strained, perhaps beyond recognition. For example, the exposition of Marx given here stresses the transitivity of the elements of the human labour process and the contextual character of utility. These are areas formally present yet largely unexplored in Marx' own descriptive account. Is this reading justified? As we have seen, these dynamic aspects of Marx' account are completely absent from contemporary labour process accounts. And whilst the sources of productivism in industrial sociology is itself an area ripe for enquiry, the absence of this broader reading does contribute to the tentativeness of the reading offered here.

A note of qualification is needed here: it is not the intention to suggest that Marx' emphasis on context and specificity has been "overlooked" by Marxian writers. Reading can only ever be historically specific, and thus contemporary readings of Marx are inevitably shaped, for example, by the theoretical influence of culturalism. It seems, however, significant to note that Marx' concept of labour process has been given such a productivist reading by contemporary labour process writers. And equally significant that Marxian culturalist writers have so pointedly neglected employment and technology. Both silences speak to the curious way in which technology has been constituted in sociology.

3. In a similar vein the account of cultural studies, the culturalist view of work, and especially the suggestion that the products and processes of paid work may be viewed as a symbolic as well as a material process, strains the as yet barely developed theoretical repertoire of the culturalist perspective. Whilst there appears to be nothing to confine culturalist analysis to work in the more obvious areas of representation and sub-culture, there is as yet no cultural studies of employment, or, more accurately, no studies which acknowledge the ways in which meaning production is shaped by the relations of paid work.

4. There is an additional conceptual area where the analysis is open to criticism: this is in the way in which the concept of work is deployed in the thesis. In striving to transcend the manufacturing conception of work in labour process literature, the aim here has

been to develop a concept of work which relates to human labour in both paid and unpaid contexts. The danger is, of course, that the category work is capable of expanding potentially to embrace all human activity. Of particular concern here, however, is not so much what are the limits of the concept work, as what are the limits of the work that contributes to "technology". As we have seen, the culturalist perspective has the potential, at least, to develop a concept of work which is neither productivist nor economic. The culturalist accounts of work discussed here emphasise the production of subjectivity, meaning, and class and gender positions. Yet there is a considerable analytic gap between these hesitant explorations and a clear theoretical purchase on the forms of work which contribute to "technology". The accounts of particular workplaces offered here have largely served a negative function, not to provide a clear perspective on the relations between the material and the representational in work, but rather to underline the difficulties of developing a culturalist account of technical workplaces.

5. It has been argued here that technology cannot be understood solely in internalist terms; that a sociological exploration of the exclusive and special character of technology requires analysis of social action outside the conventional sphere of technical work. The constitution of technological 'specialness' cannot be understood solely by reference to technical workplaces. The thesis has argued that the category "technology" is produced and consumed in a wide range of human work and workplaces. This approach has two dangers: firstly it is difficult in general to know

which work and which workplaces are excluded from the account; Secondly the approach runs the risk of suggesting a sharp distinction between cultural and material production. I do not want to suggest that physical forms are relatively fixed whilst cultural products are dynamic in their attachment and detachment from objects. On the contrary, I would want to propose the view that, in this respect, there is no difference in the products of human labour, simply different modes of analysis - material and symbolic.

6. A further limitation to this thesis, and to the development of a sociology of technology in general, concerns the exclusiveness of technical language, and the difficulty of finding a voice with which to discuss the sociological aspects of technology. Marx intended Capital to be read by the working man. Braverman explicitly follows in this tradition, writing with a concreteness which finds visible referents in the manufacturing workplace. Yet technology is not an easy topic for sociological debate. The apparent certainties of technical knowledge and the unfamiliarity of technical discourse set technology apart. Relatively few sociological texts directly address technology, and thus there are few models to emulate. Revealingly, feminist writers have found a voice to critique technology in science fiction, and in practical projects, yet, with the exception of Cynthia Cockburn, an academic feminist critique of technology is noticeably undeveloped. The sociological challenge is to find a voice to talk about technology, a voice which does not regard technology as special but as a regular topic for sociological analysis, without at the same time negating the significance of technical

knowledge and discourse.

7. In several places the thesis has made reference to specific workplaces. The brief descriptions have been included not as ethnography but simply to concretise theoretical concerns; this is substantially a debate with social theory, not an empirical enquiry. There is, however, more to it than that. Examples may illustrate a point, they also provide an inevitably partial view. At the same time that concreteness provides a counter to the remoteness of abstract formalism, it also risks parochialism and a version of contextual specificity from which it is difficult to make any general inference.

Where technology is concerned there are particular problems - concreteness does help to display the integration of, for example, relations of expertise, class and gender. Yet linking this local focus to the broader cultural context within which "technology" is also formed poses substantial theoretical difficulties. Accounts of interaction in technical workplaces may capture some elements of the subcultural and the economic; might point to the ways in which shades of meaning of "technology" are sustained through the flow of daily work routines; may point, for example, to the ways in which the physicality of technical objects becomes associated with masculinity and expert knowledge. Such approaches cannot, however, fully acknowledge the cultural production of "technology" which occurs elsewhere and which workers bring with them in their interpretive framework of understanding, disposition, and preference.

The exploration of concrete examples may be useful yet theoretically unconnected with the production and consumption of "technology" in other symbolic practices. This is a major difficulty: given that technology and "technology" are constituted in a number of sites, and that these sites are available to both material and symbolic analysis, what are the mediations between these sites, these practices? The next section attempts to address this question.

III MOVING BEYOND, TRANSCENDING MATERIAL AND CULTURAL DIVISIONS

The argument of this thesis suggests that a sociology of technology needs to embrace and cohere a number of elements which have hitherto been pulled apart and treated as separate in social theory; this division lies, it seems, at the very heart of the difficulties of developing a sociology of technology. Proposals for a sociology of technology then are necessarily related to wider problems in social theory.

The thesis has pointed to the ways in which the constitution of technology takes place on many sites, within many human labour processes. It has been acknowledged that the tools for exploring the constitution of technology in differing workplaces have barely been formulated. There is the yet more serious difficulty of tracing the relations between workplaces which together constitute technology. The difficulty has been expressed here in relation to technology, yet represents a broader concern for social theory. Recent debates have attempted to address this difficulty, occasioned by what are seen as significant shifts in the patterns of capitalist accumulation. Whilst this commentary does not explicitly address the sociology of technology, nevertheless the form of the debate does offer some glimpse of a way forward.

The following discussion points to two attempts to move beyond productivism, and, within a marxian framework, to develop a culturalist reconceptualisation of production and consumption.

In the mid 1980s the relatively narrow concerns of labour process writers gave way to a more optimistic notion of the transformation of working relations. (See Wood, 1989 for a summary.) This debate about transformation considered the extent to which increasing flexibility in manufacturing systems, and changes in patterns of quality control and worker participation, represented a radical change in the prevailing relations of production.

Present concerns with flexibility herald a rupture with the assumed past domination of Taylorist and Fordist methods, themselves often automatically associated with mass production. According to the Americans Piore and Sabel (1984) the result will be what they call flexible specialization, or Kern and Schumann (1984) from West Germany label the end of the division of labour, Tolliday and Zeitlin (1986) in Britain the end of Fordism. (Wood, 1989 p.3)

Flexibility in both production and consumption was seen to be made possible by the technologies of computer aided design and manufacture linked to computer based ordering. The technological ability to switch production lines, to adopt a fast and flexible response to changes in expressed consumer preference, brought the relation between production and consumption to the forefront of the analytical agenda. The significance here of the transformation debate is that it signals the possibility of a developed account of work, and of technology, which reaches beyond the traditional concerns of industrial sociology.

These broader societal implications of the new manufacturing flexibility were taken up with enthusiasm by the British Communist Party and elaborated in their journal Marxism Today. The authors of New Times, the changing face of politics in the 1990s, a collection of Marxism Today articles, argue that we are living through a moment of significant historical shift, a conjuncture of epochal import.

The 'New Times' argument is that the world has changed, not just incrementally but qualitatively, that Britain and other advanced capitalist societies are increasingly characterised by diversity, differentiation and fragmentation, rather than homogeneity, standardisation and the economies and organisation of scale which characterised modern mass society. (Hall and Jacques, p.11)

Contributors to New Times explore not only changed relations of manufacture but also take into their embrace shifts and developments in many other areas of social life: in ecology, identity and personal consumption, North/South relations, and political culture. Some critics have sought to dismiss the New Times approach on the grounds that it is technologically determinist (for a detailed discussion of technological determinism in New Times, see papers by Pelaez and Holloway; Barbrook; and Levidow in Science as Culture, 1990). Yet the range of issues addressed in New Times relates more to a Gramscian notion of social life. In this light, New Times may be seen not as determinist but as a flawed attempt to construct a way of reaching beyond productivist

accounts of technology and of work. There is, however, one aspect of the New Times scenario which is less coherent. The New Times elaboration of the many facets of what they present as an important conjuncture do not appear to be part of any theoretical framework - they simply occur together.

An extraordinary feature of the post-Fordist thesis is that, although it is an argument based on the transition from an old order to a new order, surprisingly little attention is paid to the question of why and how such a change is taking place. In almost all accounts, from the more popular to the more academic, the emphasis is not on change, but on the juxtaposition of two models, the old and the new, and on working out the implication of those models. What appears to be a theory of history is, on closer inspection, a static, structural-functionalist analysis of society. In many of the accounts, the New Times are simply treated as having 'emerged' from the failure of the old system. (Pelaez and Holloway, 1990)

Pelaez and Holloway may have overstated their case here, and they give little sense of what would be an appropriate alternative. There is however a more fundamental point here concerning the theoretical basis upon which social change is conceptualised. New Times writers suggest that there has been a significant shift in their object of knowledge: capitalist relations of production. It may equally be the case that the limitations of Communist Party theorising were becoming so apparent that a radical reconceptualisation was

called for. The point remains however that there is a fairly stark analytical choice between a model of change which charts shifts in a number of equally valued areas of social life, or a model which gives theoretical priority to some forms of social action, industrial production for example. This point is developed in the following discussion relating to the work of David Harvey.

The argument of this thesis is that the development of a sociology of technology rests upon finding a way of moving beyond the theoretical divisions of materialist and culturalist analysis. And New Times does appear to embrace a wide range of social phenomena, many far removed from the point of production. Yet, whilst such changes are presented as conjunctural, there is little or no attempt to explore the mediations between these sites of supposed change. Yet Marxism Today base their New Times scenario on an elaboration of post-Fordist analyses. And post-Fordism does have a more solid theoretical base in the French Regulation School of political economy - a school of thought which does attempt to indicate the wider framework within which economic and cultural shifts occur.

DAVID HARVEY : A CULTURALIST RECONCEPTION OF PRODUCTION AND CONSUMPTION.

In The Condition of Postmodernity David Harvey sets out the ideas of the Regulationists in terms of two concepts: a regime of accumulation; and a mode of regulation.

A regime of accumulation 'describes the stabilization over a long period of the allocation of the new product between consumption and accumulation; it implies some correspondence between the transformation of both the conditions of production and the conditions of reproduction of wage earners.' A particular system of accumulation can exist because 'its schema of reproduction is coherent.' The problem, however, is to bring the behaviours of all kinds of individuals - capitalists, workers, state employees, financiers, and all manner of other political-economic agents - into some kind of configuration that will keep the regime of accumulation functioning. There must exist, therefore, 'a materialization of the regime of accumulation taking the form of norms, habits, laws, regulating networks and so on that ensure the unity of the process, i.e. the appropriate consistency of individual behaviours with the schema of reproduction. This body of interiorized rules and social processes is called the mode of regulation'. (Harvey, quoting Lipietz, pp.121-122)

Harvey deploys these Regulationist concepts to explore the complex of economic and cultural shifts which appear to mark post modernity. He focuses particularly on the ways in which temporal and spatial dimensions of capital accumulation have changed in the post modern era. Harvey's exposition is detailed and wide ranging, a dazzling array of cultural and economic relationships which previously appeared to be separate and unconnected. Harvey provides, above all, a

demonstration, an example of how to address the widely diffuse fragments which make up contemporary society. In three respects Harvey's work has particular relevance for the development of a sociology of technology, in each respect his work relates to the problem of mediations.

Firstly, Harvey demonstrates a mode of analysis, a way of talking about the economic and the cultural, without theoretical disjuncture or discontinuity. Secondly Harvey addresses the relationship between the general and the particular, between meta-narrative and local specificity. Thirdly, through a discussion of fetishism and ephemerality, Harvey provides some insight into the relations between technology and "technology". These points are discussed in turn. The focus of the discussion that follows is not a detailed consideration of Harvey's work, rather the aim is to raid his analysis for those elements which can contribute to this most resistant of difficulties in the development of a sociology of technology. Harvey, then, is here included as the peg on which to hang discussion relating to narrowing the gulf between traditions of marxian political economy and cultural studies.

SPANNING ECONOMIC AND CULTURAL MODES OF ANALYSIS

By developing Regulationist ideas, Harvey presents a non-productivist account of capital accumulation.

The virtue of 'regulation school' thinking is that it insists we look at the total package of relations and arrangements that contribute to the

stabilization of output growth and aggregate distribution of income and consumption in a particular historical period and place. (p.123)

Harvey goes to the heartland of productivist industrial sociology, the car industry, to concretise his point.

One only has to contemplate the whole complex of forces implicated in the proliferation of mass automobile, production, ownership and use to recognise the vast range of social, psychological, political, as well as more conventionally understood economic meanings which attach to one of the key growth sectors of twentieth century capitalism. (p.123)

On this account the direct, Fordist, control of labour is no longer seen to be the key definer of capitalist relations of production. Rather the control of labour power is seen in the broadest sense to be a product of the mode of regulation.

The socialisation of the worker to conditions of capitalist production entails the social control of physical and mental powers on a very broad basis. Education, training, persuasion, the mobilization of certain social sentiments (the work ethic, company loyalty, national or local pride) and psychological propensities (the search for identity through work, individual initiative, or social solidarity) all play a role and are plainly mixed in with the formation of dominant ideologies cultivated by the mass media, religious and educational institutions, the various arms of

the state apparatus, and asserted by simply articulation of their experience on the part of those who do the work. (pp.123-124)

This widely embracing notion of capitalist relations suggests a way of theoretically fusing materialist and culturalist dimensions of work - and thus of the work of producing and consuming technology.

Harvey rejects the idea that cultural life "is outside rather than within the embrace of capitalist logic".

I see no difference in principle between the vast range of speculative and equally unpredictable activities undertaken by entrepreneurs (new products, new marketing stratagems, new technologies, new locations, etc.) and the equally speculative development of cultural, political, legal, and ideological values and institutions under capitalism. ...Precisely because capitalism is expansionary and imperialistic, cultural life in more and more areas gets brought with the grasp of the cash nexus and the logic of capital circulation. (p.344)

Harvey's canvas is wide, and his broad brush strokes suggest rather than elaborate. In the passage above, for example, he points to a way of exploring cultural production and consumption without losing touch with the insights offered by the Marxian conception of capitalism. He emphasises speculation and unpredictability, not pattern and certainty; his analysis leaves space for human agency, human creativity. Harvey here hints at least to a

'capitalism of the cultural', to an approach that does not reduce the "cultural, political, legal, and ideological values and institutions" to mechanical models of production; to an approach that does not see entrepreneurial activities in solely economic terms.

In common with the Marxian culturalists discussed earlier, Harvey appears to see "the logic of capital circulation" as having an analytic potential which is neither economistic nor productivist. Harvey at once presents a culturalist view of shifts in economic life; and brings the insights of marxian political economy to bear on the fashions and trends in cultural life and thought.

There have been earlier acknowledgements of the necessary coherence between cultural forms and the mode of production. Harvey draws on Gramsci, writing about "the new type of worker and [the] new type of man" brought about by Fordist relations.

The new methods of work 'are inseparable from a specific mode of living and of thinking and feeling life.' Questions of sexuality, the family, forms of moral coercion, of consumerism, and of state action were, in Gramsci's view, all bound up with the search to forge a particular kind of worker 'suited to the new type of work and productive process'. (p.126)

It has been argued here that the divisions between economic and culturalist perspectives relate both to the different theoretical approaches which each adopt (the circulation of value, the circulation of cultural

forms) and the objects of knowledge which each addresses (economic activity of the workplace, and the representational activity of home, leisure, and cultural industry). Following Gramsci, Harvey's analysis offers a version of capitalism which spans the economic and cultural aspects of life, without positing a sharp division between, say, industrial and domestic workplaces.

With his stress on production and consumption as part of a more comprehensive view of social change, Harvey's work seems to offer one way of grasping the mediations between technology and "technology", and thus his analysis seems to have potential for a sociology of technology. The offer is suggestive rather than developed, for whilst discussion about internal relations/hegemony/coherence in society is not new to social theory, such discussions have rarely been applied to integrate the macro-economic with the subcultural (as Willis, Williams, and Winship attempt to do), still less to the ways in which these relations may serve the study of technology.

In one sense the argument of this thesis may be stood on its head. Rather than focus on the sociology of technology, the concern may be seen to be with the divisions which exist between materialist and culturalist perspectives. Instead of exploring the elements of a sociology of technology, the discussion may be seen to address a specific problem in social theory - with the sociology of technology providing a limiting case. In this context Harvey's approach, his particular version of Marxism, makes the interconnections between political economy and culture

more visible; by this means he indirectly provides a way of conceiving of technology as a physical and symbolic social phenomenon within the broader context of a mode of regulation. Harvey provides a glimpse of the theoretic possibility; his broad scope, however, leaves much to be explored in determining how these mediations may be explored in the particular case of technology.

THE PARTICULAR AND THE GENERAL

Postmodernist analyses lay stress on diversity and fragmentation rather than on the coherence of grand theory. Harvey assesses postmodernism thus

...in its concern for difference, for the difficulties of communication, for the complexity and nuances of interests, cultures, places, and the like, it exercises a positive influence. The meta-languages, meta-theories, and meta-narratives of modernism... did tend to gloss over important differences, and failed to pay attention to important disjunctions and details.

Postmodernism has been particularly important in acknowledging 'the multiple forms of otherness as they emerge from differences in subjectivity, gender and sexuality, race and class...(Harvey quoting Huyssens, p.113)

Postmodernism then can be seen as inserting texture and complexity into the meta-narratives of social and cultural theory. Whilst Harvey warns against the dangers of reducing all social action to a language game, he nevertheless applauds the move away from over

simplified universals toward the more subtle distinctions that postmodernism reveals about "fragmenting social landscapes" (p.114).

This thesis has turned to the particular to give concrete accounts of work concerned with the democratisation of technological production and consumption, and with socially useful production. These have provided a brief, partial, and imprecise glimpse of the minutiae of work in a technical environment. What they cannot do is to clearly and unequivocally demonstrate the elements of labour process, or some symbolic contribution to the constitution of "technology". Social interaction is necessarily more messy than that. Yet, seen in a postmodernist light, these accounts take on a different meaning. What these accounts, these outlines of what Foucault calls the "micro politics of power" may do is to point to some of the many social fragments which together form the social phenomena of technology.

The brief outline of work at the technology network emphasised gender divisions, competing definitions and ownership of the technical, and the minute ways in which those distinctions are sustained and reproduced. The attempt has been to bring these events into a broader theoretical framework. Is that an unnecessary quest for an all embracing explanation? Can it be that technology is no more than a collection of these facets? Is it possible that the many associations of technology with hegemonic power are not part of a more fundamental social process?

In a similar vein, seen from a postmodernist perspective - one which emphasises surface appearance, cultural discontinuity, and jostling varieties of taste - then the discussion of utility in chapter seven takes on a different perspective. Highly local and contextual definitions of utility are, for postmodernists, inevitable. There can be no broadly contexted usefulness, no attempts, like the Skip Lighting Project, to serve some common good, no popular expressions of preference.

Harvey robustly attacks the nihilism of this aspect of postmodernism.

But in challenging all consensual standards of truth and justice, of ethics, and meaning, and in pursuing the dissolution of all narratives and meta-theories into a diffuse universe of language games, deconstructionism ended up, in spite of the best intentions of its more radical practitioners, by reducing knowledge and meaning to a rubble of signifiers. (p.350)

In order to avoid just such reductionism, the discussion in this thesis has focused solely on Marxian writers in the culturalist tradition. The thesis has also offered concrete examples of working relations.

The theoretic intention here has been:

- to move away both from the relative simplicities of economistic Marxism, and from the danger of reading off from Marxian analysis to workplace description.
- to resist notions of capitalist relations of production as a smooth unfolding of Marxian certainties, and to point instead to the texture and

inconclusiveness of working relations.

- to give due weight to the contribution the local and the specific may offer to a sociology of technology, and by this means to try to provide a glimpse of the constitution of technology in the minutiae of relations of class, gender and expertise in the technical workplace; to gain some purchase on the ethnographic constitution of technology.

There is, however, a broader concern. The thesis has argued that the social phenomenon technology may be understood through an exploration of the concept of work. But the concepts of technology and of work are necessarily abstract. They refer to a vast variety of relations, products, and processes. The danger is that, in attempting to provide a sociological counter to the abstractions and social exclusions associated with technology, technical abstraction is replaced with equally exclusive sociological formalism and theoreticism. By stressing the specificity of working relations, the aim here has been to emphasise human agency in the relations of technical work, to stress the possibility of a Marxian ethnography of technical work.

For a sociology of technology - in a society where technology is seen to be specialised, exclusive, asocial, and a motor of modernity - the uncovering of the mediations between specific appearance and more embracing analysis is crucial.

FETISHISM AND EPHEMERALITY

Another way of tackling the theoretical division between political-economic and culturalist perspectives, expressed here as the relation between material technology and the category "technology", is to consider the ways in which the surface appearance of technological products becomes detached from the material relations of production. Harvey draws from Marx to address the question of fetishism - the ways in which real but superficial relationships mask their origins.

The conditions of labour and life, the sense of joy, anger, or frustration that lie behind the production of commodities, the states of mind of the producers, are all hidden to us as we exchange one object (money) for another (the commodity). We can take our daily breakfast without a thought for the myriad people who engaged in its production. All traces of exploitation are obliterated in the object (there are no finger marks of exploitation in the daily bread). We cannot tell from contemplation of any object in the supermarket what conditions of labour lay behind its production. (p.101)

By evoking the Marxian concept of fetishism, Harvey speaks to the means by which products, commodities, not only mask the details of their production but, further, take on a life of their own. This is one version of the separation of real relations and the commodity form. (And where a formal sociology of technology is concerned, an important one. Working from the technical commodity back to the conditions and

relations of production provides one means of taking technology from a pedestal of automatic efficiency to reveal its human origins. There are finger marks, but they take some uncovering, and this can prove a powerfully educational process.) There is, however, a second version of the separation of real relations and the commodity form. That is the separation between the artefact and its imagery.

Harvey presents postmodernism as a concern only for the appearance, the mask, and the processes of masking - to the neglect of real relations of production and between production and consumption. He asserts that modes of representation mask production.

Advertising and commercialization destroy all traces of production in their imagery, reinforcing the fetishism that arises automatically in the course of market exchange. (p.102)

Harvey's comments appear to suggest a base/superstructure model here - one which gives theoretical priority to one set of producers and one aspect of production. Yet analytically it is difficult to see why some producers take precedence over others. If we look, for example, at the production of cars we see both artefact and its intimately associated cultural life. The production of film has a similar character, as do advertisements, novels, plays. Indeed it is difficult to think of human work, of production and consumption, that does not have both a material and cultural dimension. On this view advertising and commercialization does not "destroy all traces of production" but are themselves

producers in both the material and cultural sense. It then becomes important to distinguish between the processes of masking which attach to commodification, and the processes of representation which are the product of, say, the advertising industry. There are real (material) relations and appearance to all products. Where technology is concerned this duality - material and symbolic - refers as much to the production of technical hardware as it does to, say science fiction films, advertising imagery, and other products which contribute to the cultural life of technology. In the case of technology, it is the collage of differing forms of production and consumption that comprises the totality.

At first sight such an approach seems to run against the tide of this thesis, to give priority to the physical, to the notion of a material base. What then of areas of work where material production is less identifiable? What of workplace relations, technical discourse, even school syllabi? How may these processes, these less physical forms of social production be seen in both a material and a symbolic light? They have a material expression, one which is necessarily integral to the cultural life of those social products. The view taken here does not seek to reduce work, production, social life to material relations, but to extend the notion of both real relations and appearance to all kinds of work. Most particularly work which contributes to that cluster of social phenomena, technology.

Harvey further draws a distinction between the physical object and its representation.

Advertising ...is no longer built around the idea of informing or promoting...but is increasingly geared to manipulating desires and tastes...If we stripped modern advertising of direct reference to the three themes of money, sex, and power there would be very little left. (p.287)

Yet the creation of needs and desires cannot be so simple, cannot be the domain solely of advertising. Harvey's analysis ignores the symbolic dimensions of physical products and only barely acknowledges the physical existence of advertising products. This thesis has resisted the notion that production and representation may be distinguished by differing arenas of work, the distinction must surely be in the mode of analysis.

To what extent then does David Harvey succeed in offering a mode of analysis which transcends the post modernist debate about culture and the post Fordist debate about the economy? His key terms, Fordist modernity and post modernist flexibility, starkly signal his intention - to address economic and cultural change within a unified theoretical approach.

David Harvey has been largely successful in pointing to the possibility to transcend theoretical divisions, yet to some extent the old problems of prioritizing the material base reappear, and in a form that is particular relevant to a sociology of technology.

The question raised by Harvey's attempt to embrace both material and cultural phenomena within the 'logic of

capitalism' is whether it is possible to retain a Marxian approach whilst not giving priority to some forms of work over others. Harvey appears to opt, ultimately, for a prioritising of physical production. The approach here has been to argue for the material and symbolic dimension in all work. This does not mean that all work must be viewed as equally influential. Where the constitution of technology is concerned that is clearly not the case. It does mean a more specific focus for allocating theoretical priority is required. There is nothing self evident about physical production that demands priority.

The thesis has pointed especially to the separation of political economy and culturalist analysis as a impediment to the development of a sociology of technology. This problem is not specific to the study of technology, yet (because of its physical facticity and cultural legitimation as 'special') technology does provide a particularly interesting example of the theoretical fissures. The problem is broader than a sociology of technology but critical to it. Thus a fundamental requirement of a sociology of technology is to bring together these twin modes of analysis. Harvey's work represents an ambitious and masterly attempt to address the broad sociological problem - the discussion here has attempted to relate that to the specific concerns of a sociology of technology.

The search for a sociological analysis of technology is not to be understood as a quest, nor emphatically should technology be seen as a holy grail. The thesis has shown that there is a sociology of artefacts to be derived from a marxian concept of labour process, and a

sociology of "technology" to be found in marxian culturalism. There is, however, no one concept of technology to be entrapped within sociological analysis. There is a cluster of meanings, referents, and usages which together comprise the category. And, it has been argued here, to gain any theoretical purchase on that category demands attention both to the material and the symbolic. Harvey provides some hint of how these two traditions may theoretically be fused. However, I believe there is a limit on the extent to which the constitution of technology can be explored in this way. The argument is in danger of becoming too abstract, too detached from the phenomena; the analytical category technology could all too soon take on the very rigidities of technology in popular discourse.

The task ahead, the elaboration of a sociology of technology, is a daunting one. The outlines of a theoretical project have been suggested here. And, in a more indirect way, the mode of investigation is also suggested. The theoretical drift of Marxian political economy and cultural studies implies an investigative approach which emphasises particularity and specificity. A focus on the social complexities of everyday work may also serve to provide a language for talking about technology in non-specialist language. Such an approach would also direct attention to context and use rather than to artefacts or technical accounts.

To be sociologically effective, the argument requires a move away from the general notion of technology to particular instances, uses, contexts. The fusion of political economy and cultural practice occurs

everywhere, and inevitably in everyday work. The sociological task is to recognise the particular ways in which specific technologies are, by this means, engineered.

APPENDIX I
MICROCOMPUTERS IN EDUCATION

APPENDIX I REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

Linn, P. (1985). 'Microcomputers in education – Dead and living labor'. *Radical Science*, (18), 58-101.

APPENDIX II
THAMES TECHNET PROJECT ASSESSMENT CRITERIA

THAMES TECHNET PROJECT PROPOSAL ASSESSMENT CRITERIA

All projects are assessed for network support using the following set of general criteria:

- i) Socially useful in broad terms:
 - previously unmet need
 - involvement in development by end user/consumer
 - use of wasted resources
 - concern for local environment
 - builds on/enhances existing skills
 - attempts to look at new ways of working in terms of organisation structure and decision making processes
 - attempting to break down the usual barriers associated with technology/production.
- ii) Technical feasibility of the product/service.
- iii) Have Thames TechNet the resources to support and assist or would this best be referred to another more appropriate agency.
- iv) Is this duplication? New project developments are not intended to create new jobs at the expense of existing ones unless there is a clear departure from existing similar products/service e.g. the product has been modified in clear consultation with the end user or a non-traditional method of production or working will enhance the workers skill and involvement.
- v) There is evidence of forward planning particularly in terms of job creation potential and the quality of the jobs being created/protected. All users must be willing to take on a full equal opportunities policy with regard to all aspects of staffing and in the operation of the business.
- vi) A good indication of the market being aimed at: i.e. some attempt at a market analysis. Other areas of re-application of the product idea need to be considered to increase the market potential.
- vii) An indication of costs both in producing and selling the product/service idea. If possible some forward costings should be provided.
- viii) Patent/Registered Design: all involved in project development activities on any particular project should be aware of their position with regard to patent/design rights, patent infringement, payment of royalties, etc.

- ix) All user groups should be prepared to remain in Greater London, preferably the South East, whilst being assisted by Thames TechNet.
- x) Project developments need a clear time plan to ensure the most effective use of the network's resources and the successful move into production/service or license arrangements. User groups must take on this responsibility in conjunction with the network staff.
- xi) Actual and potential involvement by other agencies, organisations in developing project ideas needs to be clearly defined to ensure effective working. Other agencies involvement in a project idea should not necessarily ensure Thames TechNet assistance above those without such support as the reasons for non support could be institutional racism, sexism of which Thames TechNet does not wish to perpetuate. Assistance from Thames TechNet may unlock other forms of funding and assistance and this needs to be considered at the proposal stage.
- xii) Business Plan: help can be provided from Thames TechNet via such agencies as the Thames Poly Business School but the user group must be involved with this essential process and preferably linked up with a local training initiative if necessary. The network should, where possible, use the resources of the local Employment Development Units in the local councils and local Co-operative Development Agencies who have particular expertise and monies available to help with generating business plans and cash flows.
- xiii) Preference should be given to potential users living and working in South East London, particularly those more disadvantaged in industrial society, i.e. disabled, women, the black community and ethnic minority groups such as the Vietnamese.
- xiv) Thames TechNet user need to commit a realistic amount of time to developing a project proposal. Potential users of the workshop also need to ensure that time spent in the Thames TechNet Centre on development work will not affect any state payments they may be receiving.
- xv) An assessment of the appropriate skills needed to develop and successfully operate a business venture may require network staff ensuring that users needing training, whether updating skills or obtaining new ones, are referred to the appropriate agencies, e.g. GRETA. which will be able to assist. The network without being a formal training initiative can provide informal training to users through actual development work carried out by staff in conjunction with the users.

- xvi) Information on the potential or existing business set up. The network aim to ensure that workers have an involvement in all levels of development and operation of a successful business, and support workers co-operatives as the most appropriate means of achieving workers' participation.
- xvii) Identification of financial resources available to the user group. Existing firms/co-ops will need to provide some financial statement on the business. Looking at the possibility of linking into obtaining the MSC initiative, the Enterprise Allowance.
- xviii) Acceptance of the health and safety policy of the Thames TechNet.
- xix) Clarifying the position on any existing contractual arrangements regarding the proposed project development activities to be undertaken.

APPENDIX III
FEMINIST VIEWS OF "NEW TECHNOLOGY"

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FEMINIST VIEWS ON "NEW TECHNOLOGY"

Appendix IV contains comment on the ways in which writers addressing the social impacts of new technology have contributed to the 'new technology' phenomenon. This brief review of feminist writing has a similar aim, to point to the ways in which feminist writers have contributed to "new technology" and have positioned women in relation to that technology.

Whilst there are many strands to feminism, a major strength of modern feminist literature has been the rejection of social and political analysis which focus exclusively on the economy and the public domain. Feminists have instead sought to develop analyses which at least recognise and, at best, embrace both the public and private spheres of social life. Yet in their commentary on new technology the socialist and radical feminists reported here do not focus on the public and private interactions which comprise new technology. Instead they reproduce economically driven popular notions of new technology - even while they adopt a recognisably feminist stance. In this way, as the examples below demonstrate, feminists have contributed to the production, the constitution of the new technology phenomenon within feminist debate.

Here are some examples of the themes to be found within such literature. They indicate the tendencies uncritically to celebrate the capacities of new technology; the tendency to see the hardware of production abstracted from the social concerns of the

workplace; and an apparent willingness to accept manufacturers' claims for a new technology as radically different from that which went before.

Writing in the Women's Studies International Quarterly, Arnold, Birke and Faulkner argue for the inevitability of new technology developments.

In the UK, both the State and the Trades Union Congress have made substantial commitments to furthering microelectronic technology - which puts the trades unions in the invidious position of supporting a technical change which is already putting large numbers of people out of work. It is, of course, now impossible to opt out of microelectronics, even if we thought it desirable. Both the cheapness of microelectronics and their reliability militate against the use of earlier technologies because the firm which does not use microelectronics is at a competitive disadvantage. (Arnold, Birke and Faulkner, WSIQ Vol4.No.3, 1981, p.327)

Three common assumptions appear in this extract. Firstly, that 'earlier technologies' are the sole alternative to microelectronics. Choices within the production, distribution, and consumption of new technology are not here recognised, still less the gendered character of those choices. Secondly, that new technology causes unemployment, thirdly, that the government is committed to new technology. These last two views were regularly rehearsed in the popular, political, and academic media during the period of high concern about new technology, 1978-1982. Yet

empirical research on the employment effects of new technology has been necessarily inconclusive in a time of severe economic recession in both old and new industries. This is particularly so where estimates of women's employment levels are concerned since increasing numbers of employees have been forced into marginality. The extent of government commitment to new technology is difficult to quantify. The three National Enterprise Board initiatives were soon sold off or disbanded; Department of Trade and Industry support for the Microelectronics in Industry scheme was substantially withdrawn in 1983; funding for the Microelectronics in Education Programme was not renewed when the first allocation ran out in 1985; and there have been unprecedented cuts in academic research. The Alvey Programme into fifth generation computing appeared to be the only area of government investment in new technology, even though most of the research projects were geared toward military rather than commercial needs. In 1987 the Government announced that there would be no successor to the programme, leaving no Government policy on Information Technology. None of these initiatives addressed the relative exclusion of women from status positions with the new technology industries, neither were they requested to do so by the Trades Union Congress or by the opposition. The inevitability then relates as much to the gendering as it does to the economic effectivity of new technology.

Nostalgia for a craft tradition is part of the deskilling argument. Feminists too have a hazily defined notion of less fragmented work in the past; their nostalgia finds expression in the analysis of

word processor technology.

Thus, workers under capitalism perform increasingly specialized but simple tasks. They become increasingly dependent on the capitalist because they lose the skills required to make commodities under a social division of labour. Increasingly, too, they lose touch with the workings of their tools - as far as the word processor operator in the office is concerned, it is simply not relevant to understand how the machine works. (Arnold, Birke and Faulkner p.329)

Typists have not usually been conversant with their mechanical devices. The situation is no different with word processor operators: but the point is more fundamental than that. Few, if any, workers are familiar with every aspect of every tool required for the job. Word processor operators do need to have considerable knowledge of the conventions, vagaries, and idiosyncrasies of both the software and the hardware if they are to bend the system to their intentions. The essentialist, and indeed physicalist, implications of 'lose touch' run through much of the literature associating 'new technology' with deskilling and increasing subordination of labour. Thus debates about changes in work organisation are displaced, from a focus on the relations of production and toward the particular technology which is associated with these more structural shifts. By this means the debate becomes not only technologically determinist but also gender blind to the different ways in which men and women workers relate to technological artefacts.

Feminist comments on word processing generally isolate keyboard skills to the neglect of all the other tasks which word processor operators - in a wide diversity of settings - encompass in their daily routine. Just as industrial relations and labour process writers have focused on the automobile assembly line as a motif for capital's domination of commodity labour, so, too, feminists have emphasized the most dehumanised application of word processor technology and ignored the majority of operators working at a stand-alone machine and involved in the coming and going of the peopled office.

(Word processing) increases the extent to which the typist is tied to her desk ('workstation') and reduces the extent to which she is free to pace her own work. A crucial factor is the skill characteristics of the pool of labour available to management. Even typing itself involves varied tasks at present: changing paper, typing, arithmetic for text centering, page layout and so on. Word processing deskills the typing tasks by means of such facilities as easy correction, automatic text centering and automatic layout. Thus, while still requiring some basic ability to operate a standard keyboard, word processors dispense with the need for layout skills and high levels of keystroke accuracy. (Berch, 1983, p.30)

A double abstraction occurs here - the whole battery of social arrangements for getting copy transformed into text are ignored, whilst the technical claims and focus of word processor manufacturers, addressed to

management-purchasers, is reproduced.

Perhaps because of a greater familiarity with the technology, feminist writers have focused on word processing as an area of women's work subject to the increasing pacing, surveillance, and monitoring made possible by new technology. In terms of worker control, there seems to be little that is new about the technology of word processing. Women workers, often part-time, have, since the 1950s, been subjected to high degrees of monitoring and control in data processing departments. For the past thirty years, punched card departments have employed a strict, technology assisted, discipline. When, in the late 1960s, such departments turned to key-to-disk input methods, technology-assisted forms of pacing and monitoring were routinely available. Yet these workplaces have not attracted sociological attention, nor have these technologies been seen as an especially sinister arm of capital, or of patriarchy. The scale of microelectronic miniaturization and the dramatic increases in telecommunication speed, has prompted much debate on the possibilities for a decentralization of production - including an increase in female homeworking and the export of data preparation work to Third World countries.

Using satellite technology, routine tasks such as data entry, database management and coding can be beamed back to New York, San Francisco or Sidney from India, Singapore or the West Indies for a fraction of the cost of employing indigenous workers. (Else, 1982, pp 33-34)

There are several areas of technicist thinking in this projection. Each confirm the extent to which the representations of new technologies mystify the limitations of those technologies. Firstly, the significance of the latest technology is over exaggerated. Satellite technology does not itself aid or promote the export of data processing work: transatlantic telephone cables - older than computer technology - are as effective and serve exactly the same purpose. (Callers to New York have no way of telling whether satellite or undersea cable is servicing them.)

Secondly, data relating to the process of production cannot easily be abstracted from other parts of production: an over estimate of the significance and discreteness of data lies at the heart of Ursula Huws book on computer related homeworking The New Homeworkers. And it is only possible to conceive of a significant increase in data processing related homeworking if data is seen as separable from the interrelationships of the productive process. However, this runs counter even to the aims of systems design where the focus is to so organise data capture that subsequent data entry is not necessary. (A common example of this occurs when we use a street cash dispenser. Not only do we by-pass the cashier, but we also - in the very process of entering a security number and specifying the amount required - perform the data entry task.) The question is not so much about whether an increase in homeworking will come about as a result of information technology, but rather to ask whether this is a possible given other features of the organisation. Those who predict new forms of

homeworking do so by assuming that these forms are determined by technological change.

These brief extracts demonstrate the extent to which the representations of new technology - with associations of domination for marxists, and as efficient automation for conservatives and liberals - go unchallenged by feminists. The efficacy of new technology is assumed. In the process of accepting and reproducing that representation, feminist commentary has only the 'impact on women' to discuss.

APPENDIX IV
POPULAR AND JOURNALISTIC REPRESENTATIONS OF NEW
TECHNOLOGY

APPENDIX IV

POPULAR AND JOURNALISTIC REPRESENTATIONS OF NEW TECHNOLOGY

The broadcast, in March 1978, of the BBC Horizon programme "Now The Chips Are Down" may be seen as a public starting point for the publishing explosion commenting on the consequences of change and "convergence" in electronic, computing, and telecommunications technologies. Whilst the 'social impact of the chip' became a fashionable focus for concern which lasted until the early 1980s, there had been a number of earlier publications; several prestigious reports had already been produced by the United Kingdom and other governments (see note 1). And public concern in the media over the effects of new information technologies had also been pre-empted in sociology - where forecast and debate about the character of "post-industrial society" had waged since 1974 (see note 2). Despite these precursors, the television broadcast seemed to mark a turning point; governmental policy changed (see note 3) and an avalanche of commentary on the social and economic effects of 'the chip' started to descend on a public already in the throes of oil-price related recession.

Forester's collection, The Microelectronic Revolution: the Complete Guide to the New Technology and its Impact on Society brings together a range of material produced at this time, meanwhile more populist commentary (see note 4) together with statements from political parties and trades unions (see note 5) made a contribution to the debate about the 'impact' of new technology.

Analysis of the effects of The Chip, then, emerged from governmental, academic, journalistic, and party political sources. Yet despite the contextual diversity of their authors, a striking similarity of analysis is evident in these publications. With an emphasis on the 'pervasiveness' and 'convergence' of these 'heartland technologies' authors focused upon the new information technologies as though they represented a unique and radical shift in technological power. The following themes recur in the literature of this time:

THE INEVITABILITY OF RAPID CHANGE

Changes in microelectronic and computer technology were presumed to be radically different from any previous technological change. Even Robert Noyce - whose work was seen to be central to the development of the microprocessor - foresaw a quantum leap.

The evolution of electronic technology over the past decade has been so rapid that it is sometimes called a revolution. Is this large claim justified? I believe the answer is yes. It is true that what we have seen has been to some extent a steady quantitative evolution; smaller and smaller electronic components performing increasingly complex electronic functions at ever higher speeds and at ever lower cost. And yet there has also been a true revolution: a qualitative change in technology, the integrated microelectronic circuit, has given rise to a qualitative change in human capabilities.

(Sci.Amer.1977 p.63)

With apparent awe and deference writers discuss the unprecedented rapid rate of change which, they believe, to be inevitably associated with the new information technologies. The focus is not on whether change will occur, but on the direction and consequences of a presumed and unquestioned rapid rate of change. Both the Trades Union Congress and the Labour Party share this view:

Technological change and the microelectronic revolution are a challenge, but also an opportunity. There is the challenge that the rapid introduction of new processes and work organisation will lead to the loss of many more jobs and growing social dislocation. Equally, however, there is the realisation that new technologies also offer great opportunities - not just for increasing the competitiveness of British industry but for increasing the quality of working life and for providing new benefits to working people. (TUC,1979)

The most visionary of science-fiction writers could not have predicted the transformation wrought by a mere forty years of micro-technology development. The scale and speed of change has produced every response from terror to intoxicated optimism. Somewhere in between those extremes is the historic lesson that, if we are to avoid the fate of other generations that have experienced

technological revolution, we have to subordinate the new assets to human need and social control so that we are the beneficiaries rather than the victims of change. (Neil Kinnock, in Large, 1984)

There may well be a social imminence associated with new products, with the opportunity for new areas of profitability. But the writers above ascribe that imminence for change to technically determining sources. They are unable to explore the social particularities of these new technological practices, and thus have strategies to 'harness' inevitable change rather than to generate an analysis for a transformation of new information technologies.

NEW TECHNOLOGY AS A GENERATOR OF WEALTH

The new information technologies were seen to be central to economic survival and national competitiveness.

...This country's future trading performance will depend greatly on its ability to compete in world markets for products and services based on Information Technology and on the rapid and effective application of such products and services by industry and commerce generally.

...(Information Technology) a key point in the future growth of the economy.

ACARD Report (1980)

Its difficult to see how one particular technology can bear the weight of this economic optimism when competitiveness arguably comes from a whole range of

governmental, financial, and industrial policy making.

THE FETISHISATION OF NEW TECHNOLOGY

These technologies are presented as extraordinary, not only in terms of speed, size, and declining cost, but also in terms of their range of application: New information technology, it was claimed, would enter all aspects of social life, in new products, new services, and new processes of production.

...the silicon chip is becoming all-pervasive in industry and commerce, the universal machine that can revitalise virtually all other machines, the 1980s equivalent of the nuts and bolts of the first Industrial Revolution.

(Large 1984 p.174)

Associated with this enthusiasm for the wide applicability of the new information technology is the way in which many writers reproduced this curious focus on the microprocessor, curious since microelectronics and computing, although powerful, form only one part of useful goods and services; they offer no motive power, neither are they the sole component in products. By emphasising the microprocessor, other aspects of these new technology-related goods and services go unexamined. The part is taken for the whole. The Department of Industry, in this picture and accompanying text, appear to be suggesting that the microprocessor can be straightforwardly substituted for electro-mechanical technology.

The contrasting photographs deny the many costs and risks associated with changing a major component in a product line. In the protracted process of change, Servis no doubt had to consider a number of factors, for example, contractual obligations and uncertainties with suppliers and customers, staff training, job re-design, re-tooling, and marketing. These practical aspects of production are not recognised in the technical choice presented by the Department of Industry. Their repeated focus is on the microprocessor component. Writing from a more radical perspective, Counter Information Services show a picture of a woman with a microprocessor on her nose, the intention was probably to convey the scale of miniaturisation. The effect is more likely to suggest that this component alone will bring about change, will usher in new products, services, and processes of production.

An emphasis on technical possibility and an associated neglect of the social changes necessary to produce new products and processes, is, of course, characteristic of a technological-determinist analysis. In the case of the new information technologies the determinism appears to centre largely on one component - the microprocessor - to the exclusion of all the other technical and social changes necessary to bring projected products and production processes into being.

THE FETISHISATION OF INFORMATION

A similarly technicist focus on the abstracted part rather than the social whole is evident in the focus on information to be found in the social impacts

literature on new technology. Stonier (1982) puts "information" alongside land, labour, and capital as a fourth factor of production, whilst others also stress the centrality of information as a new commodity. The Department of Industry (1981), for example, go so far as to describe information as "The Food of Progress". Daniel Bell also placed information at the centre of social change.

In the coming century, the emergence of a new social framework based on telecommunications may be decisive for the way in which economic and social exchanges are conducted, the way knowledge is created and retrieved, and the character of the occupations and work in which men engage. This revolution in the organisation and processing information and knowledge, in which the computer plays a central role, has as its context the development of what I have called the postindustrial society.

...The axial principle of the postindustrial society, however, is the centrality of theoretical knowledge and its new role, when codified, as the director of social change.

(D.Bell "The Social Framework of the Information Society" in Forester. pp.500-501)

New technology, it was claimed, would do for brain power what the industrial revolution had done for muscle power.

The Japanese saw it first...and called it the Information Society....The theory of the Information Society is...that information is becoming the key resource, demoting the

traditional production factors such as capital, labour, land and raw materials.

...Professor Tom Stonier...has presented a structure of three industrial revolutions. The first dealt with machines that extended human muscles; the second with machines that extended the human nervous system (radio, television, telephones, films); and the third, the computer-based information revolution, producing a post-industrial economy, deals with machines that extend the human brain.

(Large, 1984 pp.40-41)

New technology is presented as the only way to master the "Information Explosion".

The concept of abstracted information is a difficult one to apprehend. The prioritisation of commodity 'information' has, like the focus on the microprocessor, the effect of abstracting 'information' from social contexts in which it has existence and meaning. Whilst the new information technologies provide ways for the storage, manipulation, and rapid transmission of data, the concept of 'information' is defined by utility and relevance in particular contexts - a definitional context which is excluded from Large's analysis.

THE EMPLOYMENT EFFECTS OF NEW TECHNOLOGY

A further characteristic of social impacts literature about the new information technologies is the certainty with which writers predict the widespread changes to the organisation of work which, they allege, follow in the wake of the development of these technologies.

Employment effects, the chief concern of all commentators, are generally seen as bad but avoidable, although commentators differ in their antidotes or palliatives to high unemployment: they stress the general benefits of wealth creation consequent upon the deployment of the new technologies; call for organised resistance; point to job retraining and worksharing strategies; argue for central planning to ensure phased introduction and rational deployment of new technology and/or the equitable distribution of new technology-related profitability. The Department of Industry typify the more optimistic alternatives to employment effects.

IT is also transforming old industries, taking away boredom, removing danger, making factories cleaner, more pleasant places to work. It is also improving efficiency and productivity and so enabling Britain to compete and create new wealth and higher standards of living.

(D.of Ind. "There's no future without it" 1982)

Professor Freeman suggests that more rigorous economic analysis itself provides a means of averting technologically related mass unemployment. Developing "the spring and ebb tide" of Kondratiev's long wave analysis, Freeman appears at once to both embrace and dismiss economic structuralism to predict that

...in the race between job-generating investment and technical change and job-displacing technical change, I would expect job displacement to draw ahead in the 1980s. But I do not regard this as an inevitable or irreversible fatalistic process.

But only if we are aware of the strength of the long-term tendencies in this direction, will it be possible for the world economy to move in a different direction. (Holst Lecture, 1978)

Writers appear to have an eager acceptance of many claims for the new technology, especially manufacturers' claims for declining payroll costs and increasing automation.

Your first impression when you view the McDonnell Douglas parts fabrication plant in St Louis is the sheer size and loneliness of it all. Some two dozen acres of milling machines noisily grind grooves, slots and intricate patterns in airframe parts to a tolerance of 0.0025 inch. The machines, for the most part, work alone -watched by only a few men who glance occasionally at a control panel or sweep the cuttings.

(N.P.Ruzic "The Automated Factory" in Large, p.165)

There are, however, grounds for doubting the capacity of "automatic" or self-acting processes.

NEW TECHNOLOGY AS AN INTELLIGENT DISPLACER OF HUMAN LABOUR

The above extract, from the Director of the National Space Institute in Washington, represents a wider phenomenon, a general willingness to see the new technologies as not only a displacer of human labour, but also as a substitute for human labour in a wholly unique way. There is nothing surprising about a machine executing a task so, on the face of it, there

should be nothing surprising about an entirely mechanised factory. But the notion of machine - however automated - embraces the idea of human direction and, where necessary, human intervention. The idea of an automated factory excludes the element of human direction (which some would see as a necessary element in purposeful work). The new information technologies are seen as "intelligent" and capable of realising the dream of automation. There are, however, several reasons to doubt the likelihood of realisation, since it takes large amounts of human effort to construct a microelectronic assisted device which will imitate a fragmentation of human labour - even a task as apparently simple as securing a bolt. And, further, there is a considerable difference between machinery which may imitate human labour and the conscious execution of purpose which characterises human labour at work. This distinction, between artefacts and human work, between machines and people, will be discussed more fully in chapter six.

The enthusiasm for 'automation' is strange since, by itself, technological hardware cannot produce useful goods, human labour is inevitably required to bring goods into a context for useful consumption. But the idea of automation is compelling, an engineering dream of order, precision, and predictability. Real production, in real factories, in real time does not have these properties - it is full of complex vagaries, unforeseens, and external circumstances. Unlike technical abstraction, real production is constituted by clusters of interrelated social relations, as this thesis tries to show.

One specialised category of 'social impact' literature comes from writers working at the interface of psychology, philosophy, and computer science (see note 6). The wide ranging debate about the practicality, morality, and efficacy of 'artificial intelligence' provides a clear illustration of the tendency to see computer technology as uniquely different from any previous technology. The anthropomorphism of 'memory' and of 'intelligent', 'smart', 'interactive', and 'learning' computer software required by artificial intelligence or 'expert systems' suggests not only an optimistic view of the capacity of technical products but, at the same time, an emiseration of the concept of human intelligence and experience.

Social impacts literature, then, has characterised the new information technologies as radically different, economically central, and flexible in their range of application. Two abstracted entities, the microprocessor and information, are presented as the focus of major social changes with inevitable employment effects; and the new information technologies are seen as a means of achieving large scale automation.

In outlining the particulars of the new information technologies, social impacts writers have contributed to a powerful conception of technology and technological change. By focusing on the consequences of new information technologies, or technical change, social impacts writers make a split between the technical and the social and are unable to explore those significant social changes which are necessarily integral to the development and deployment

of new techniques and new technologies. This theoretical reluctance to engage with the social constitution of particular technologies has the effect of falsely attributing an homogeneity to the many practices, divisions of labour, and organisational contexts which are embraced within 'new technology'.

For a time the new information technologies were the subject of a great deal of social commentary and prediction. The consequence of this media attention was not only public awareness but alarm about the 'new technology' phenomenon. In part, the enthusiasm to publish commentary on the social effects of new information technologies itself constituted the phenomenon.

The popular debate which began in the late 1970s concerning the impact of the new technologies provides a specific example of technological determinist approaches to social change. The eager enthusiasm with which social impacts writers have greeted the new information technologies itself provides an interesting sociological phenomenon. Their willingness to take new technologies at their face value, to see new technologies as representing a radical historical break with other means of production, appears to suggest some suspension of critical judgement. It is difficult to imagine a non-technical commodity which would have so much social force ascribed to it. Sociological reluctance to engage with technology as a social product serves to reproduce the notion that the design, development, and constitution of technology is of 'technical' rather than social concern.

One important role for sociology is to examine the powerful interests at work in the construction of popular imagery, and of hegemonic movements. It seems curious that, where new technology is concerned, sociologists have been unable to de-naturalise the glamour of progress and inevitability associated with new technology.

By accepting, rather than challenging, the popular images of 'revolutionary' new technologies, the writers noted above have themselves become part of the ideological constitution of 'new technology'.

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1. See, for example, Advisory Council for Applied Research and Development, (1978) The Application of Semi-Conductor Technology, London, Cabinet Office, HMSO.

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2. See, for example, Bell, D. (1974) The Coming of Post-Industrial Society: a venture in social forecasting. London, Heinemann.

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3. Shortly after the March 1978 broadcast, the Department of Industry began to set up the various strands of the Microelectronics Application Programme (MAP) to disseminate information, training and consultancy in order to insert microelectronics into the processes and products of British industry. At the same time the National Enterprise Board set up three costly ventures: INMOS (chip manufacture), NEXOS (office systems), and INSAC (computer software). Later, March, 1979, the Department of Education and Science produced the £12.5m Microelectronics in Schools programme.

4. See, for example,
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5. See, for example, Association of Professional, Executive and Clerical Workers (APEX) (1978) Office Technology: The Trade Union Response, London.

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6. See, for example,
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inquiry into the history and prospects of artificial
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APPENDIX V

WORKING WITH PEOPLE

A PAPER WRITTEN BY PAM PERCY

DESCRIBING HER ROLE IN

SETTING UP THAMES TECHNET

The paper was published in Radical Science Journal No.13 (1983). That issue was addressed to scientism in left-wing thought, and included a critical paper "We won't be Fooled Again: Economic planning and Left Strategies", by Les Levidow. This paper forms a response to the economism of the Levidow paper.

APPENDIX V REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

Clark, P. (1983). 'Working with people'. *Radical Science*, (13), 100-104.

APPENDIX VI

A REVIEW OF M.COOLEY (1980) ARCHITECT OR BEE?

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