“Temples of Power” - Space, Society and the Textile Mill, *c.*1780-1930

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ABSTRACT

This thesis is concerned with the archaeology of the textile mill. It explores the archaeological evidence for the ways in which factories, as physical structures, mediated labour relations, power structures and social change over time and concentrates on the ways in which architectural form, style and symbolism, and internal spatial organisation reflected and generated ways of controlling production and the workforce. At the heart of this research is a detailed archaeological case study of a sample of textile mills from the Yorkshire cotton and worsted industries covering the period *c.*1780 to 1930. By selecting a sample of mills from within a closely defined geographical and industrial context, an understanding of the evolution of the Yorkshire textile factory as a distinct building type during the long period of British industrialisation is established and set in the context of wider social and cultural change during the early modern period.

It proposes that the textile mill played a key role determining labour and wider social relations during the industrial revolution. The factory system not only represented a departure in terms of the organisation of production, it also represented a major spatial change and demanded the development of a new building type. It is argued that the physical structure of the textile mill was used to frame labour relations and as a mechanism through which a number of different social and business relations were structured and reproduced over time. In this way, this thesis attempts to move the study of the textile factory, and industrial buildings *per se,* beyond a basic technological and functional agenda and instead to consider the social dimensions of production.

Although at heart a study of specific type of material culture, the textile factory, this thesis aims to contribute to a broader intellectual discussion. At one level, it is interested in the potential of material cultural studies to contribute to our understanding of the industrial revolution and in exploring the reasons why, hitherto, the study of the physical remains of the industrial revolution have played such a limited part in our interpretations of the period. It therefore draws on the work of historians with particular attention to historical models of organisational and social change in the development of the factory system. However, whilst it makes use of concepts borrowed from industrial history the agenda pursued here and the interpretations offered are primarily archaeological. At another level, this thesis seeks to establish a research agenda for the wider study of industrial and early modern buildings with an emphasis upon their social and cultural significance.

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ACKNOWLEDGEMENTS

'... I suppose it was worth it, I 'd do it again, But I just couldn't face it...'

Tommorrow Never Comes K. MacColl (1994)

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AUTHOR'S DECLARATION

Some of the ideas and arguments expressed in this thesis have previously been published by the author elsewhere: Mellor, I. 2005. 'Space, society and the textile mill', *Industrial Archaeology Review*, XXVII (1): 49-56.

All the images in this report are the authors own unless otherwise stated. Extracts from OS maps are included by permission of 'Get-a-Map' (Ordnance Survey).

LIST OF ABBREVIATIONS

Throughout the text a number of abbreviations and conventions are used. They are as follows:

RCHME	Royal Commission on the Historical Monuments of England
BFO*xxxxx*	Sites from within Yorkshire but not including the case studies, are referenced with their National Monuments Record/Buildings File number as in the RCHME Yorkshire textiles mills gazetteer (Giles and Goodall 1992).

References to the 12 case studies in the main text (the case studies are presented in Appendix A) are given as Appendix A and site number: for instance, Aireworth Mills, Keighley (**A1**). In order to cross-reference between figures from Appendix A referred to or reproduced as plates in the main text, the following convention is used - Appendix A, site number and page number thus: (**A1**, Figure 1.1: A2).

Oral history transcripts consulted at Bradford Reference and Study Library are reproduced in Appendix B, but in the main text are referenced by the transcript numbering system used by the Bradford Reference and Study Library and page number as reproduced in Appendix B: for instance, **A0001**, B3-B4.

CHAPTER ONE
AN ARCHAEOLOGY OF CONTROL

> '*To Arkwright and Watt, England is far more indebted for her triumphs than to Nelson and Wellington. Without the means supplied by her flourishing manufactures and trade, the country could not have borne up under a conflict so prolonged and exhausting*' (Baines 1835, 503-4)

1.1 INTRODUCTION

The architecture of industry represents a tangible link with the industrial past. Many of the historically unique transformations brought about by the British industrial revolution are reflected in a period of extraordinary building activity and the emergence of a distinctive and striking built environment (King and Timmins 2001, 328). In the space of only a few decades a host of new building types evolved. Some, like mills, warehouses and railway stations, were in the direct service of industrial production, whilst others served new social needs, new urban functions, new commercial processes and new patterns of legal and constitutional control (Conway and Roenisch 2004, 1; Markus 1982, 1). In a twenty-first century context, and in light of changed economic circumstances including the geographical re-location of many industries and the introduction of new methods of production, the question of the survival and reuse of industrial buildings has become a major issue for both the conservation and urban regeneration movements (see English Heritage 1995a; 1995b; 1995c; Stratton 2000; Cattel *et al* 2002). The surprising success of the regeneration of the industrial built environment, particularly in urban settings, has brought about a significant change in attitudes – industrial buildings are no longer seen as blackened relics of a disturbing past, but as the heart of new urban living and a symbol of renewed vitality. Furthermore, many industrial sites and buildings have acquired an amenity value as popular visitor attractions (see, for instance Stratton 1996; National Trust 2004). This process of regeneration and reintegration as part of the modern landscape and cultural environment has been part of a wider and more fundamental shift in our value system and the way we perceive the places where we work and live (HRH Prince of Wales 2000, 4).

The industrial heritage has in many ways, therefore, begun to acquire new significance to modern society and to a large extent this renewed role has been responsible for the neutralisation of many of the negative connotations associated with the industrial past (Casella and Symonds 2005, *xi*). This thesis, however, is concerned with the contribution of industrial architecture to social and cultural life *during* the British industrial revolution between the late eighteenth and early twentieth centuries. Mokyr (2001, 1) has suggested that a major characteristic of the industrial revolution was the increasing separation of the place of consumption (the home) and the place of production (the industrial plant). Accordingly, there is a direct relationship between the movement of many industries out of the domestic setting and the development of new building types suited to these new modes of production. Changes to the dominant mode of production were also commensurate with fundamental changes to labour relations. In many instances, the movement of work out of the domestic setting and into the centralised workplace has corresponded with the establishment of hierarchical workforces and the development of new relationships between workers, managers and factory owners. This itself, of course, was symptomatic of wider social change, in particular the rise of the working and capitalist classes. Industrial architecture may therefore be firmly linked to the social context of the industrial revolution.

A particularly explicit example of the shift towards mass, centralised production is evidenced by the factory system of production. Perhaps one of the most distinct case studies of the emergence and development of the factory system during the industrial revolution was within the textile industries. Indeed, the textile factory or mill has often been considered the epitome of the development of the factory system of production (Trinder 1992, 189; Markus 1993a, 189), whilst when many of the first textile mills were built in the late eighteenth and early nineteenth centuries, the terms 'mill' and 'factory' were synonymous (Berg 1994a, 189). The textile mill therefore provides a compelling case study of not only the emergence of a new building type and a new mode of production, but also of the development and maintenance of a complex web of labour and social relations. It is also of considerable archaeological interest. Few other industries have left architectural remains as impressive, diverse and widespread, both chronologically and geographically, and the survival of a high proportion of mills is an obvious reminder of the pre-eminence of the textile industry during the industrial revolution (Falconer 1993a, 5). This thesis seeks to explore the material evidence for the ways in which textile mills, as physical structures, created, mediated and maintained labour relations, power structures and wider social change.

1.2 'TROUBLE UP T'MILL?' SPACE, SOCIETY AND THE TEXTILE MILL

The idea that the archaeological study of the textile mill has the potential to inform us about labour and social relations during the industrial revolution is based on the belief that the built environment is meaningful in the realm of social relations and an active constituent in social practice. We experience buildings in two different but complementary ways. On the one hand, our experience of the built environment is physical, it concerns the built form and the structural as well as the aesthetic and functional aspects of buildings. But buildings also have a metaphysical existence; they express meaning and give certain messages (Conway and Roenisch 2004, 22). The ways in which these experiences and messages are conveyed and understood have as much to do with the user as they do the architect of the building. As a consequence, our understanding of, and the way in which we define 'architecture' should recognise that it is made by both design *and* use (Hill 1998, 11). A central theme of this thesis is the concept that buildings can be used to impose social control, which, in other words, implies that the built environment may be designed in such a way to be authoritarian. In the context of the factory system of production this has two potential applications. First, it implies that the physical structure of the factory as a place of work played a role in structuring hierarchical labour relations through supervision of the workplace and differential use of space by different members of staff. Second, and by extension, those same labour relations mediated inside the factory may have played a role in framing wider social relations. In this context, the factory building as a landscape feature is particularly important.

Of course, the idea that the factory system of production was developed because of the benefits of centrally organised and supervised workforce is neither new nor unexplored. However, hitherto, little or no attempt has been made to demonstrate a clear link between the logic of managerial enterprise and the architecture of the factory. In contrast, studies of the factory have tended to be dominated by technological and functional interpretations, a position eloquently summarised by Peter Davey (1994, 4):

> 'But buildings for manufacture are much more informed by technology and process than concern for people who, since the Industrial Revolution, have been subservient to machinery'

This apparent preoccupation with the technological and functional aspects of the factory reflects the underlying assumptions of a broader and deeply embedded corpus of literature concerned with the study of industrial architecture.

Traditionally the architecture of industry has received only superficial or passing attention (Jones 1985, 1) and has played only a minor role in the social and economic histories of the period (Markus 1982, 1). A predominantly empirical approach has been the orthodoxy, characteristically descriptive and particularising rather than analytical and generalising. Industrial architecture has typically been examined in terms of products, manufacture and profits earned and it was common for different types of industrial building to be described and classified in terms of the technologies and processes that they housed rather than as architectural statements in their own right.

This bears testimony to the fact that the architecture of industry has principally been attributed to the 'practical' rather than the 'artistic' architect (Holmes 1935, 12), a view underpinned by the belief that solely functional or technological considerations are central to the physical attributes of industrial buildings (Riley 1998, 91). This position was embodied by J.M. Richards' *The Functional Tradition in Early Industrial Buildings* (1958), which sought to raise the profile of a range of buildings:

> 'whose architectural virtues have not yet been fully recognised and to illustrate in action a tradition of forthright functional design... which emerges particularly strongly in the architecture of the industrial revolution' (Richards 1958, 7)

Richard's work on industrial architecture, however, is paradoxical. His positive approach to these buildings and his recognition of their often unique architectural form owes much to the fact that he sought to establish the architecture of the industrial revolution as one of the origins of the Modern Movement (Watson 1990, 180), but in doing so he succeeded in pigeonholing industrial buildings as 'utilitarian'. We may indeed call this approach to industrial architecture the 'functional tradition'.

The dominance of this 'functional tradition' is clear from a review of traditional approaches to the study of the textile mill. The dominant and orthodox view has studied the mill solely in the context of the development of machinery and power sources within the textile industries during the industrial revolution, whilst a similarly pervasive agenda has sought to establish the place of the mill in the development of structural engineering, with particular regard to the evolution of the iron-framed building (see Baines 1835; Mantoux 1928; Skempton and Johnson 1962; Pacey 1969; Charlton 1971; Chapman 1971; 1981-2; Curl 1973; Falconer 1993a; 1993b; Milln 1995; Holden 2005). Only recently have efforts been made to set the study of the mill in a 'multiplicity of contexts' (Trinder 1992, 189) and these have included the history of structural engineering and architecture, the development of the textile industries, local topography, and the socio-economic history of community and region. This type of broadly contextual approach found its greatest expression in the work of the former Royal Commission on Historic Monuments in England (RCHME). During the last three decades of the twentieth century the RCHME undertook the extensive and intensive survey of textile mills which resulted in the publication of a trilogy of books concerned with the textile mills of the north of England (see Giles and Goodall 1992; Williams and Farnie 1992; Calladine and

Fricker 1993). Other isolated recording projects of mills, elsewhere in Britain, were also carried out (see, for instance, Calladine 1993; Menuge 1993). However, on the whole, most of this work has remained largely descriptive and the greatest effort was expounded on understanding the technological and functional aspects of the textile mill with, for instance, a marked emphasis on the evidence for power sources, power transmission, and the relationship between the structural elements of the mill and the processes and machinery that it housed.

Why then has the 'functional tradition' proved to so tenacious? At a broad level it undoubtedly reflects post-industrial attitudes towards the industrial period. Ironically, as well as being the world's first industrial nation, Britain was also one of the earliest countries to experience the trauma of industrial decline (Stratton 2000, 8). The failure of growth in British industry since the 1960s has encouraged historians to study the industrial revolution in order to search for the origins of the British malaise (Hudson 1992, 9). Decline has also ensured the persistence of negative attitudes towards the industrial past, itself a partial reflection of wider attitudes in working- and middle-class society, as well as within the academic community, towards the history of industry and manual labour (Cranstone 2004, 2). As a consequence, the academic potential of industrial buildings has been largely overlooked, or rather ignored completely. It is therefore not surprising to find that where they have been studied, industrial buildings have been subjected to limited research agendas that have principally taken a descriptive and functionalist approach. Where stylistic or architecturally elaborate examples of industrial architecture have been encountered, the functional tradition has ensured that the aesthetic qualities of the building have been played down, passed over, treated as exceptions or simply swept aside (see, for instance, Crawford 1990; English Heritage 1995c; Stenvert 1999).

The application of functionalist reasoning to the study of industrial buildings also reflects the fact that these qualities have undoubtedly been the easiest to identify and describe. That industrial buildings were designed to house specific processes is well evidenced in their physical form and in historical sources, but that does not preclude the fact that industrial buildings might reveal evidence for other factors responsible for their form, such as the structuring of labour relations. It should be stressed that whilst this thesis is explicitly concerned with exploring the evidence for these social dimensions, it does not mean that other factors, such as technological determinism and economic efficiency, will simply be discounted. Rather, it seeks to establish new interpretations of industrial architecture that move beyond a purely functionalist agenda. It therefore seeks to contribute to an existing corpus of literature on industrial architecture, the textile mill, and the factory system through the exploration of an archaeological agenda specifically suited to the study of the social dimensions of production.

Efforts to explore such an alternative agenda have, however, been forthcoming in recent years, and offer a tantalising view of the possible interpretations to be made of industrial architecture outside of the functional tradition. In the context of the textile industries, Campion (1996; 2001) and Palmer and Neaverson (2001a) have examined the archaeological evidence for the ways in which the spatial arrangement and stylistic elements of the architecture of the textile, frame-work knitting, and footwear industries, played an active role in controlling production and social activity, particularly at the level of worker communities and out-working. Central to these studies has been a framework of inference based on the belief that the built environment is meaningful in the realm of social behaviour. Yet, these studies remain largely the exception in a field dominated by the functional tradition.

1.3 STRUCTURE OF THE STUDY

To summarise, it is clear that, hitherto, industrial buildings have rarely been studied as physical expressions of human behaviour and that industrial archaeology, which is well placed to set such an agenda, has fallen short of fully exploiting this form of industrial age material culture. It is this major intellectual issue that this thesis seeks to address, proposing that there is an acute need for a research agenda that moves beyond purely functional interpretations and acknowledges the social dimensions of production during the period. It draws on Braudel's (1982) insistence that without the social dimensions of production, technology and manufacture make no sense, and aims to explore these issues in the context of the factory system in the textile industries. The overriding contention is that a new understanding of industrial buildings as a mode of social behaviour offers a promising approach to the materiality of the textile mill. In doing so, it aims to establish a wider framework for a distinctively archaeological approach to the architecture of industry.

This thesis therefore engages with and is framed by a number of different intellectual dialogues. A major theme is a specific concern with the fact that industrial archaeology has hitherto contributed little to our understanding of industrial architecture and examines why it has largely continued to perpetuate a functional approach to industrial revolution material culture. Broadly expressed, these issues reflect the origins and development of industrial archaeology as a discipline, post-industrial attitudes to the physical remains of industry, and the wider intellectual difficulties of the study of material culture from historic periods. This thesis therefore recognises that these issues have meant that industrial archaeology has tended to contribute little to our wider understanding of the social and cultural parameters of the industrial revolution.

In contrast, historians have pursued a far more extensive agenda and have drawn attention to the social aspects of the industrial revolution, and this thesis therefore examines the potential for industrial archaeology to turn its attention to similarly non-functional interpretations. Germane are historical models of the origins and development of the factory system, in particular those which have sought to explain its emergence (epitomised by the textile mill) in terms of changes to the organisation of work, the microeconomics of the firm (managerial logic) and transformations to labour and labour relations. Crucially, this thesis draws on the work of T.A. Markus who, in his seminal work *Buildings and Power – Freedom and Control in the Origin of Modern Building Types* (1993a), presented a model of the factory that has archaeological potential for the exploration of the technological and social aspects of the factory system. His model of the development of the physical form of the factory as a response to functional and social requirements is of particular interest and this research proposes to articulate this model in order to explore the ways in which the factory was used as a material mechanism for the structuring of labour and social relations during the industrial revolution.

On the basis of this archaeological research agenda it will be argued that industrial archaeology has the potential to examine similar facets of the factory system through the study of factory buildings. Essential is the development of a distinctively archaeological agenda drawing on the work of buildings archaeologists and an understanding of buildings as a mode of social behaviour such as that developed and used by sociologists, buildings archaeologists and architectural theorists. In recent years, the use of such a theoretical position by buildings archaeologists (see, for instance, Johnson 1993; Gilchrist 1994; Giles 2000) working within historic periods has seen something of a convergence in agendas between historians and archaeologists, and this thesis is intended to contribute to this intellectual development.

The major thrust of this research is therefore twofold. On the one hand it is concerned with the archaeological study of control and authority in the context of the workplace, specifically the textile mill, whilst on the other hand it is interested in the contribution of material culture studies to our understanding of changing labour relations during that long period of industrialisation between the late eighteenth and early twentieth centuries. It aims to establish the means by which factories as physical structures mediated labour relations, power structures and social change over time, concentrating on the ways in which architectural form, style and symbolism, and internal spatial organisation reflected and generated ways of controlling production and the workforce, and the wider implications of this for social relations outside of the factory. A major concept, then, is the idea that the architecture of the textile mill was explicitly authoritarian and deliberately designed to control labour and wider social relations both within and outside of the factory site.

The first part of this thesis is concerned with a detailed consideration of the rationale underlying the research agenda to be employed and the intellectual content within which its methodology is situated. Chapter Two outlines the origins and development of industrial archaeology as a discipline with the specific intention of establishing the historical and intellectual context of the emergence of the discipline and past and present work in the field. This will establish the broad intellectual context of this thesis and demonstrate the need for an alternative, theoretically inclined and distinctively archaeological approach to industrial period material culture, including industrial buildings.

The first part of Chapter Three is dedicated to a critical discussion of existing historical approaches to the study of the factory system, focussing on two main positions: technological and organisational approaches. The second part of Chapter Three will consider the archaeological potential of these approaches and outlines some of the major archaeological approaches to built space and architecture that are germane to the study of the factory. Chapter Four will briefly outline the development of the Yorkshire textile industries in order to establish the historical context of the material evidence forming the basis of this research. It will also outline a methodology for implementing the theoretical approaches discussed in Chapter Three and will frame a research agenda and analytical framework for the remainder of the thesis through the detailed study of twelve case studies drawn from the cotton and worsted branches of the Yorkshire textile industry, *c.* 1780-1930 (the results of recording and analysing the twelve sites is to be found in Appendix A).

Chapter Five invites a reconsideration of our understanding of 'function' in the context of the factory and makes a detailed consideration of those elements of mill design that can be attributed to purely technological or practical factors. The purpose of this discussion is to establish aspects of the textile mill, which have a purely functional logic, and in doing so lay the foundations for a discussion of those aspects of the mill that are apparently not reflections of pure utility. Chapter Six will explore the archaeological evidence for the spatial form of the textile mill and derive social interpretations of factory space, whilst Chapter Seven will consider the qualitative aspects of mill architecture with specific attention to the use of stylistic and symbolic motifs to make further social statements. Whilst Chapters Six and Seven necessarily divorce two important aspects of architecture from each other – that is space and form – reference, where appropriate, is made between them. Chapter Eight draws together the discussion of mill architecture from Chapters Six and Seven and establishes the ways in which strategies of control were consciously structured in the form, style and internal spatial organisation of the textile mill over time and between the cotton and worsted industries. It considers the implications of control in the workplace for wider social practice and in particular examines the means by which the factory building as a physical entity was used as a mechanism through which to establish social identity on the part of the capitalist classes. It is this social dimension of production during the industrial period that has so often been neglected in past studies, but which this thesis proposes as a major element of factory design and which, as a function of a factory, demands that existing and future studies incorporate social imperatives as part of their understanding of the functioning of the factory. On the basis of these findings, this research concludes with a suggestion for a broader framework for the study of industrial architecture and proposes an agenda for the study of industrial revolution material culture.

CHAPTER TWO

INDUSTRIAL ARCHAEOLOGY - A PERSPECTIVE

> *'If it [industrial archaeology] is to be understood, it needs to be seen in the context of the ebb and flow of economic prosperity of that century [the twentieth century], of continuing evolution of a nation's social structure and of a constantly-changing popular culture'* (Trinder 2000, 39)

The term 'industrial archaeology' passed into popular usage during the 1950s when Michael Rix coined the phrase in an article in the *Amateur Historian.* In this seminal work, Rix drew attention to the material legacy of the industrial revolution and its important place in the history of the British nation, describing the effects of industrialisation as the 'greatest remoulding of the country's landscape since pre-historic [*sic*] times' (Rix 1955, 228). Of central importance was Rix's belief that study of the physical remains of industry had a significant contribution to make to wider historical debate. These sentiments echoed a wider intellectual development within the historical discipline, stimulated by a wave of post-war nationalism, which sought to firmly establish a link between human endeavour and the British landscape and which was perhaps most potently expressed in W. G Hoskins' *The Making of the English Landscape* (1955). The role and impact of industry in the landscape was immediately tangible and found an outlet in the rural history movement and, in particular, in university adult education and the Workers' Educational Association (WEA). As a consequence of the actions of these groups there developed a growing awareness of the legacy of the industrial past and its important place in the historical development of the nation. Furthermore, in many instances, these groups were the source of new historical and archaeological approaches to the physical remains of industry and a starting point for practical activities and the formation of preservation societies (Trinder 2000, 44-46; Clark 1999, 280).

Since that time, industrial archaeology has developed as a recognisable sub-discipline within the mainstream archaeological discourse, but its chief characteristic has been its predilection towards the identification and conservation of industrial monuments (Buchanan 2000, 33) and its greatest strength derived from the activities of a largely amateur community (Cranstone 2004, 314). Consequently, industrial archaeology has tended to receive marginal representation at an academic and professional level and it has struggled to develop a framework of inference removed from empiricism and a tendency towards functionalist interpretations.

Since the late twentieth century a number of practitioners from within the discipline have sought to drive the intellectual development of industrial archaeology forward and demonstrate the potential of a distinctively theoretically inclined approach to the material remains of industry (*cf.* Palmer 1991; 1994; 2004; 2005a; 2005b; Gould 1995; Campion 1996; Palmer and Neaverson 1994; 1998; 2001a; Nevell and Walker 1998; 1999; Cranstone 2004). As a consequence, considerable effort has been made to establish an intellectual 'blue-print' or set of principles to guide future directions in the field. These principles, or at least the need for them, have, generally, found acceptance from practitioners within industrial archaeology.

However, there is an apparent inertia within the field and a gulf has emerged between the discussion of new directions in the field and the development of research agendas and methodologies suited to putting those established principles into practice. Where such methodologies have emerged they have, with a few exceptions, been the product of the major protagonists of a more theoretically-aware and distinctively archaeologically approach to industrial material culture (see, for instance, Palmer and Neaverson 1998; 2001b; Nevell and Walker 1998; 1999; Campion 1996; 2001; Symonds 2005a; Palmer 2004; 2005a; 2005b). It is therefore the case that some of the most exciting developments in the field have been restricted to a relatively tight circle of practitioners and have not found widespread application or recognition, particularly within the wider archaeological community.

In the course of this chapter it will be argued that the intellectual development of industrial archaeology still remains largely ahead of practice in the field. This reflects the fact that British industrial archaeology has evolved in two separate but related directions: one strand has continued to be concerned with the preservation and conservation of field evidence and maybe be termed 'industrial heritage', whilst another strand has emerged with distinctively archaeological characteristics (Casella 2005a; Palmer 2005a, 59). These strands have resulted in some debate about the scope of the discipline and has fed back into discussion about its epistemological foundations. Before considering these intellectual issues it is therefore critical to examine the origins and development of industrial archaeology as a discipline. Such a historiographical approach allows issues germane to the future of the discipline to identified and explained by situating them within an appropriate historical and intellectual context. This approach reflects Trinder's (2000, 39) insistence that a understanding of the intellectual issues at the heart of industrial archaeology demands a critique of the development of the discipline from the earliest times. It is a case of standing on the shoulders of giants and looking further into the distance and this thesis seeks to situate itself to do just that, considering existing developments within the field and suggesting new ones.

2.1 INDUSTRIAL ARCHAEOLOGY - ORIGINS AND DEVELOPMENT

The fact that 'the serious study of industrial archaeology is a phenomenon of the second half of the twentieth century' (Palmer and Neaverson 1998, 1) largely reflects that it was not until the 1950s that sufficient interest in the remains of industry grew to the extent that a recognisable community, archaeological or otherwise, emerged and encouraged efforts to study and preserve them (Buchanan 2000, 19). However, those seeking to identify the origins of industrial archaeology as a discourse must look back further.

An interest in the legacy of the industrial revolution is discernible from the time that contemporaries first perceived an apparent movement towards industrialisation. Perhaps the earliest, and most well known comments came from travelling authors like Celia Fiennes (*c.*1685 - 1712) (Morris 1995) and Daniel Defoe (1724-26), the latter observing a 'noble scene of industry' in the Yorkshire countryside around Leeds (Defoe 1971, 500). A sense of awe in the achievements and possibilities of industrialisation was also apparent in the early days of the industrial revolution proper, eloquently expressed by Patrick Colquhoun who wrote in 1815 that 'it is impossible to contemplate the progress of manufactures in Great Britain within the last thirty years without wonder and astonishment' (Colquhoun 1814, 68).

However, as the process of industrialisation took hold, attention swung away from such positivity and instead began to concentrate on the more negative aspects. Much of that negativity was a reaction to the social consequences of industrialisation. It was therefore common from the 1830s for observers to regard the industrial revolution with distaste, repugnance, and shame (Trinder 1982, 1). Of course, these negative attitudes grew principally within a community of social commentators but their impact was far-reaching. Typical was the work of Tufnell, who remarked that the new working relations between masters and men had led each party to 'look upon the other as an enemy and suspicion and distrust have driven out the mutual sentiments of kindness and goodwill by which their intercourse was previously marked' (Tufnell 1834, 97). So it was that contemporary commentators, reformers, and historians like Thomas Carlyle (see, Ball 1929),and Tufnell (1834), and later Toynbee (1884), Charles Beard (1901), the Webbs (1919), and the Hammonds (1919; 1925) (see also Briggs 1960 for an overview of contemporary commentaries) were responsible for generating and perpetuating a negative view of industrial revolution and this in turn had ramifications for later interest in the remains of industry. Furthermore, in their work we can see the genesis of popular images of the period, many of which remain prevalent in a twenty-first century context.

Therefore, by 1900 'the industrial revolution was perceived rather like an ancestor who was both a philanthropist and a psychopath' (Trinder 2000, 39). At this time, interest in the materiality of industry was minimal, partly because it represented a past that was perceived with some distaste, but also because the majority of sites were still involved in production and therefore neither considered part of the national heritage nor deemed to be of any specific historical or archaeological interest. Such apathy was at the heart of many contemporary commentaries. Principal amongst these were popular works of travel literature, most of which excluded industrial sites from their texts, whilst others displayed a staggering technological illiteracy and disregard for the industrial period, despite its immediate relevance. The classic example is E.T. Thurston's *The Flower of Gloster* (1911), which portrayed a typically negative picture of industry, past and present. Describing the Black Country, Thurston commented on a 'charred heart of that desert of land, which is more like to death than the Dead Sea... God has deserted it - left it absolutely to the hand of man', and whilst assessing the progress of Britain as an industrial nation, he questioned the cost of that progression, juxtaposing the greatness of industrialisation with 'the utter lifelessness' and hellish character of the industrial townscape (Thurston 1911, 66). Conversely, those published works which did take an interest in industry and the industrial past were produced from within a specialist field of study. For example, although the Newcomen Society (founded in 1920 and incorporated in 1961) practised an active interest in industry, it failed to engage popular interest because of its specialist approach to engineering and technology (Cossons 1975, 2).

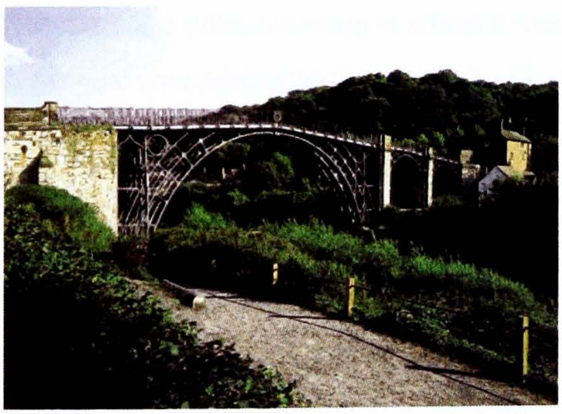
Plate 1 *Major monuments like the Iron Bridge, Coalbrookdale, were the first to attract the attention of the industrial preservation movement* (English Heritage 2003)

However, the early twentieth century did witness some efforts to safeguard aspects of the industrial heritage, but mainly those dating from the early industrial revolution in the late eighteenth century. Notably, during the 1930s the 'Iron Bridge', Coalbrookdale, Shropshire, was closed to traffic out of concern for its long-term survival (it was accorded listed status as early as 1950; Plate 1). Greater respect also began to be given to the achievements of British industry, particularly in the field of transportation. The speed records of Sir Malcolm Campbell and John Cobb were obvious sources of pride, but also notable were a series of short documentaries about the railways, including the famous *The Night Mail* (1936) (Trinder 2000, 42). However, the success of the documentary movement in simulating the public's interest proved a double-edged sword. Whilst many extolled the virtues and achievements of industrialisation, others, notably the pioneering documentary work of Grierson, did a lot to direct attention towards the plight of poverty-stricken industrial communities (Aitken 1992; Colls and Dodd 1985; Sussex 1975).

Following World War II, further efforts were made to preserve aspects of the industrial past in response to a growing feeling that something important was passing and being lost, particularly as many city centres were built following devastating air raids (Trinder 2000, 40). Notable in this period was the founding of a number of influential preservation societies, including the Inland Waterways Society (founded 1960) and the Talyllyn Railway Preservation Society (founded 1950), both of which were concerned with specific aspects of the industrial heritage.

It followed that the cause of the industrial heritage was also soon championed at an official level. In 1958 the Council for British Archaeology (CBA) set up its Industrial Archaeology Research Committee (IARC) and called a public meeting at which it was resolved that recommendations be made to national government urging national policy for the recording and protection of early industrial remains (Palmer and Neaverson 1998, 2). As a consequence, the Industrial Monuments Survey (IMS) and the National Record of Industrial Monuments (NRIM) were established and inventories accordingly created (Cossons 1975, 24-25). Notably, these inventories of industrial monuments predated the creation of the County Sites and Monuments Records (SMR).

Popular interest in the physical remains of the industrial revolution continued to grow during the 1960s and 1970s and the level of interest and the strength of public opinion at that time can be gauged from the public reaction to the controversial demolition of the Euston Railway Arch, London, in 1962 (Plate 2). Pioneering work by such luminaries as Kenneth Hudson, Neil Cossons and R. Angus Buchanan was influential in bringing some of the most significant industrial age sites and structures to public attention, whilst the pursuit of industrial archaeology was further popularised by such events as the Arkwright Festival held at Cromford, Derbyshire in 1971, and the opening of a number of open-air museums with an industrial theme. These included Beamish Open Air Museum and the Ironbridge Gorge Museum (both launched in the late 1960s), the Chalk Pits Museum, Amberley (opened in 1979), and the Black Country Museum, Dudley (established in 1975) (Stratton 1996). Specialist interest in the subject was also fostered by a series of conferences, directed by R.A. Buchanan and held in Bath and Bristol. Arguably, then, voluntary effort and the popular movement were largely ahead of official thinking (Trinder 2000, 47).

Plate 2 *The demolition of the Euston Railway Arch in 1962 aroused widespread interest in industrial monuments* (Buchanan 2000, 18)

Against this backdrop of amateur and voluntary activity, the development of industrial archaeology as a professional pursuit was slow and protracted. Pioneering work by the CBA and the former RCHME laid the foundations for a rise in professional standards in industrial recording (Falconer 2000, 66-68). More recently, specialist techniques have been developed to deal with the archaeology of industrial landscapes (Everson 1995) and sites, including the specifically 'industrial ' approach of 'process recording' (for instance see Donnachie 1969; IARC 1981; Malaws 1997; Streeten 2000; Badcock and Malaws 2004). Furthermore, increased attention has been paid to the survival of documentary records associated with industrial sites (Atterbury 1995) and ephemeral evidence, such as fixtures and fittings (Jessop 2005), reflecting an increased awareness of the importance of all categories of evidence, textual and material, in the study of the industrial past.

However, much of this work has been highly selective and has tended to reflect the interests of the individual researcher (Palmer and Neaverson 1998, 3). Prior to the 1980s few Royal Commission staff were involved in the generation of industrial records and there was a tendency to treat industrial subjects in a somewhat incidental fashion (Falconer and Thornes 1986, 25). A further problem has been a lack of synthesis (Crossley 1990, 5). The advent of Planning Policy Guidance Notes 15 and 16 (PPG15 and PPG16) in 1990 has ensured that archaeological remains, including those from the industrial period, have been accorded special consideration in the planning process. This has put post-medieval material culture on a more equal footing with that from other periods and has prevented it from being ignored through academic prejudice or disposed of as a pragmatic response to budgetary or time restraints. This has resulted in a number of significant commercial excavations with an industrial theme, and notable advances in this direction has emerged through the work of ARCUS [Archaeological Research and Consultancy at the University of Sheffield] on the metal industries in Sheffield (for instance, see Symonds 2003; 2005b). However, many of the reports relating to the material remains contacted during many commercial excavations remain 'grey literature' and there has been little attempt to synthesise this corpus of new information (Newman *et al* 2001, 1-2). Consequently, whilst many industrial sites recently recorded or excavated have been accessioned into local SMRs they have not yet been subsumed into a wider academic resource.

Nonetheless, the amassing of industrial record upon industrial record has been partially responsible for new values and meanings being ascribed to industrial landscapes, sites and structures, and has resulted in something of a wide-reaching and continuous reassessment of the industrial revolution (Cossons 2000a, 9). This has been reflected at an official level by a growing awareness of the importance of the industrial heritage and a growing professionalism in the recording, accession and retrieval of industrial records (Falconer 2000, 74). In particular, the former RCHME and English Heritage have been responsible for a number of thematic studies with an industrial theme (cf. Caffyn 1986; Baker 1991; Giles and Goodall 1992; Williams and Farnie 1992; Calladine and Fricker 1993; Thornes 1994; Bowden 2000; Cattel and Hawkins 2000; Cattel *et al*

2002; Wray *et al* 2001; Taylor *et al* 2002; Giles and Hawkins 2004). Furthermore, the Threatened Buildings section of English Heritage has undertaken specific programs of recording and aerial photography at industrial sites (Falconer and Thornes 1986, 25-27).

During the 1990s, industrial remains began to command an increasingly important place in English Heritage's remit with particular emphasis being placed on the need to protect and conserve them (see English Heritage 1995a; 1995b). This focus on the industrial heritage has continued since the merger of the RCHME and English Heritage in 1999. For instance, in July 2005, 35 buildings with an industrial theme were included on the 'Buildings at Risk' register published annually by English Heritage as means of identifying Grade I and II* listed buildings and scheduled ancient monuments at risk through neglect and decay and to provide practical advice and to establish the resources necessary in order to protect these structures for the future (http://english-heritage.org.uk). The inclusion of a large number of industrial buildings on this list, as well as an increasing number afforded listed status (Cherry 1995; 1996; 1997) and added to the schedule of ancient monuments, protected under the 1979 Ancient Monuments and Archaeological Areas Act (English Heritage 1996), reflects an interest in protecting the remains of an important part of Britain's cultural past and ensuring their survival.

The acceptance of the importance of the industrial heritage at a professional level is also typified by the growing recognition of the international importance of the industrial heritage. In 1972, The United Nations Educational, Scientific and Cultural Organization (UNESCO) adopted the 'Convention concerning the Protection of the World Cultural and Natural Heritage' with the intention of encouraging the identification, protection and preservation of cultural and natural heritage resources around the world. There followed, in 1973, the inception of 'The International Committee for the Conservation of the Industrial Heritage' (TICCIH) an organisation responsible for fostering international participation towards the identification of important industrial remains and their preservation and conservation. The first world heritage sites with an industrial theme, including Wieliczka Salt Mine, Poland (inscribed 1978), Røros, Norway (inscribed 1980; a town associated with copper mining) and the historic gold-rush town of Oruo Preto (inscribed 1980) were all associated with pre-industrial revolution age sites and it was not until 1986 when the Ironbridge Gorge, Shropshire, was designated a World Heritage Site that monuments attesting to the achievements of the industrial revolution *per se* were added to the list. No further British industrial revolution sites were added to UNESCO's list until 2000, reflecting the rather late recognition of the industrial heritage as an essential part of the 'cultural and natural heritage around the world considered to be of outstanding value to humanity' (http://whc.unesco.org) and, in particular, Britain's contribution to industrialisation. Presently, a total of 26 World Heritage Sites in Britain (23% of all British World Heritage Sites) have an industrial theme, including the Blaenavon Industrial landscape, Saltaire, the Derwent Valley Cotton Mills, the textile settlement at New Lanark and the maritime mercantile city of Liverpool (Plate 3). These inscriptions have led to an increasing awareness of Britain's unique status as the birthplace of industrialisation and in this context the work of TICCIH and UNESCO has therefore been particularly important.

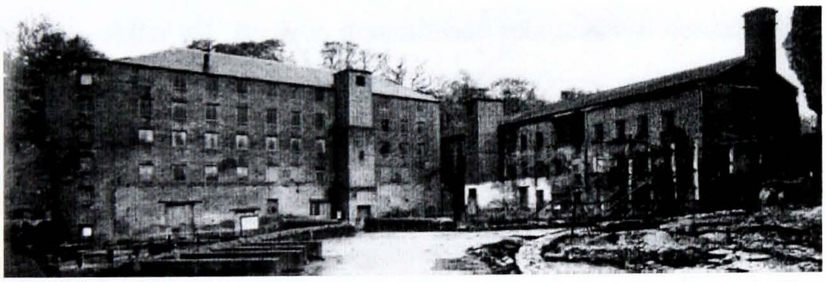

Plate 3 *Cromford Mills, Cromford, at the heart of the Derwent Valley Mills World Heritage Site (Menuge 1993, 56)*

However, official recognition of the importance of the industrial heritage and the increased attention paid to industrial remains at a professional level stands in contrast to the relative low status of industrial archaeology within the academy. Buchanan (2000, 31) noted that industrial archaeology has failed to achieve the status of an academic discipline. Despite interesting and important developments at a postgraduate level, notably from within the Institute of Industrial Archaeology at Ironbridge, Shropshire, now known as the 'Ironbridge Institute', at an undergraduate level the subject has remained marginal and poorly represented with few specialist courses offered across the British university system. This situation is compounded by a comparative lack of academic posts in the subject. Furthermore, this under representation within the academy has affected the professional and commercial development of industrial archaeology for many practitioners have received little or no training in the field (Palmer and Neaverson 1998, 1).

2.2 INDUSTRIAL ARCHAEOLOGY - THE VIEW FROM THE BRIDGE

From this brief overview of the origins and development of industrial archaeology it is clear that the discipline has developed in two related but distinctive directions. Perhaps the strongest of these has seen industrial archaeologists engaged in the preservation and conservation of field evidence, a role that might be better described as 'industrial heritage' rather than 'industrial archaeology' (Palmer 2005b, 59). Alternatively, others have pursued broader archaeological interpretations of the industrial revolution based on a more practice-orientated disciplinary identity (Casella 2005, 5). This dual focus has led some to call for a more holistic approach with greater communication between the two strands. After all, there is a symbiotic relationship between the growth of understanding, the preservation of the industrial heritage in the future and the implementation of effective conservation policies (Trinder 2000, 53) and it is only a short step from industrial archaeology as source of new research and understanding about the industrial revolution to industrial archaeology as heritage practice (Clark 2005, 116). It is therefore a matter of ensuring the future of the discipline and the material culture that it studies (Beaudry 2005, 301).

However, calls for a more holistic approach have emphasised the inadequacy of previous work in the field to contribute to wider historical debate. A major impediment has been post-industrial attitudes towards the legacy of industrialisation, perhaps because the material relicts of the industrial past are so immediate in many towns and landscapes. Indeed, such an overwhelming presence and familiarity has tended to hinder an appreciation of the importance of archaeological remains from the recent past, including the industrial heritage (Tarlow 1999; West 1999, 2-3). Such detachment and apathy has been particularly obvious within an academic context and Cranstone (2004,

314) has suggested that it reflects an explicit indifference towards industry and the heritage of manual labour arising from a largely middle-class academia. Industrial subjects were not a popular choice within the education system. The working-class, who capitalised on the post-war education system as a passport to a better life, and who were anxious either to have their working-class roots behind them or to join the socialist project in order to transform society, had little interest in studying the material legacy of their childhood. Furthermore, from a late twentieth century context, an emphasis on private ownership, free markets, and enterprise culture have all had an affect on perceptions of industrialisation (Hudson 1992, 9) and have failed to elevate the academic status of industrial subjects.

Inspired by these intellectual difficulties considerable attention has paid to establishing new research agendas within industrial archaeology with an emphasis on people and the role of human actions in archaeological narratives of the industrial revolution alongside more conventional technological and economic interpretations (Symonds 2005, 37). Central to these developments has been the recognition of the fact that it is only by adopting such a framework of inference industrial archaeology can hope to achieve a credible academic status and contribute to our understanding of the development of the modern world (Palmer 2005b, 73; Palmer and Neaverson 1998, 8).

An intrinsic part of these intellectual developments has been the desire to define the disciplinary scope of industrial archaeology and a recurrent theme is the potential of industrial material culture studies to contribute to a wider project concerned with the archaeological study of the Modern Era, which clearly draws on the ideas of the American historical archaeologist, Charles Orser (Orser 1987; 1996a; 1996b; 1999; Orser and Fagan 1995). These developments have led to limited calls for the renaming of Industrial Archaeology and alternative titles suggested have included 'the archaeology of industrialisation', 'workplace or work archaeology' or the 'archaeology of the 2^{nd} millennium' (see, for instance, Cranstone 2004; Hudson 2001). Cranstone (2005) has even gone so far as to argue that 'industrial archaeology', as a subject, is obsolete.

However, discussions about the future of the 'Industrial Archaeology' should not be reduced to the level of semantics. Clearly the major issue facing industrial archaeologists is one concerned with defining the epistemological and methodological foundations of the discipline and in that context nomenclature is irrelevant. As Casella (2005, 3) has noted, new encounters with social theory in industrial archaeology have begun to lead to wider interpretations of diversification in capitalism, of hierarchical and exploitative organisations of labour and of differing expressions of power within systems of industrial production. Consequently, industrial archaeologists *have* begun to contribute to the wider study of the archaeology of the Modern Era and without any need to rename either themselves or their discipline.

These developments broadly reflect the fact that industrial archaeology has accepted the need to end its relative disciplinary isolation from mainstream archaeological thinking. This in itself is part of a wider reaching reassessment of the role of archaeology in the historic periods within a British context. It is therefore useful to considered advances in the archaeological study of text-aided periods and to assess their relevance to the future intellectual development of industrial archaeology.

2.2.1 INDUSTRIAL ARCHAEOLOGY AND THE ARCHAEOLOGICAL STUDY OF HISTORIC PERIODS

In Britain, the study of material culture produced within historic or text-aided periods has traditionally been divided into a series of discrete and specialist areas of study because historical archaeology emerged within a field dominated by prehistoric and classical studies. (Giles 2000, 1) As a consequence, many historical archaeologies were constructed in response to the demands of research questions and priorities generated by debates within traditional history (Johnson 1996, 12), and consequently adopted the same periodisation. These chronological divisions reflected the idea of the *longue-duree*, a deeply-embedded and traditional approach in archaeology dedicated to the study of long term processes. It was therefore deemed appropriate to establish a series of progressive stages within historic periods to adhere to this model of long-term change and to create a series of steps within a wider archaeological narrative, which, together, created a sense of coherence and continuity (Courtney 1997; West 1999). However, this particularising structure tended to result in discontinuity rather than disciplinary unity because practitioners within each sub-discipline were inclined to pursue individual and specific research agendas rather than contributing towards a broader agenda for the archaeology of historic periods. The rather specialist agenda hitherto practised by industrial archaeology provides a very explicit example of this separatism within British historical archaeology.

In contrast, historical archaeologists working in an American context have sought to use archaeological evidence in conjunction with historical sources and have established an agenda firmly set within an anthropological exploration of the rise of the modern world. For American practitioners, historical archaeology is broadly seen to commence with the Colonial or 'post-contact' period and inquiry has tended to be concerned with 'the archaeology of the spread of European cultures throughout the world since the Fifteenth century and their impact on, and interaction with the cultures of indigenous peoples' (Deetz 1996, 5). Broad social questions have been asked by exploring the structure and meaning of material culture, addressing the contextual and historically specific circumstances of settlement and colonization, immigration, social organisation associated with slavery, politico-geographical divisions, and contact and conflict with aboriginals (West 1999, 7-8). This has led to a range of concepts and analytical techniques being developed in order to examine these issues archaeologically (see, for instance, Glassie 1975; Deetz 1996; Beaudry 1988).

The approach adopted in America is therefore significantly different to that practised by British historical archaeologists who have not traditionally worked within an anthropological framework and 'have preferred to treat archaeology as a separate discipline, albeit related to anthropology' (West 1999,7). Nor, until relatively recently, have they made great strides forward in studying material culture and texts in conjunction. In fact, Carver (2002) has argued that the debate about how archaeology and texts should relate has seemingly continued in a separate room to the one about whether archaeology itself is analogous to a text. This has led to attempts to reconcile two disciplines that are seen to be different because they deal with predominantly different media, texts on the one hand and material culture on the other. However, the development of a more interdisciplinary approach in historical archaeology is now considered a pivotal part of the development of the discipline (Mrozowski 1993).

British historical archaeologists have also encountered definitional problems that are not experienced by their trans-Atlantic colleagues. In the British context historical archaeology could refer to the archaeology of any period after the Iron Age, following Schuyler's (1970, 119) insistence that historical archaeology is the archaeology of literate societies. Since the genesis of writing occurred at different times across the globe (Orser and Fagan 1995, 7) it may be that the American definition of historical archaeology is chronologically too narrow and therefore unsuitable for application in much of the Old World (Andrén 1998; Funari 1999; Newman *et al* 2001, 4).

It is therefore apparent, that despite sharing a common title, British historical archaeologists have not tended to embrace the ideas and concepts pioneered by their theoretically inclined colleagues in America (Newman *et al* 2001, 3). Rather, one of the major themes underlying British historical archaeology has been the use of existing historical narratives to establish archaeological agendas, and consequently historical archaeology has often been viewed as a means of 'filling in the gaps left by history' (Deagan 1982, 156), reinforcing the idea of archaeology as some sort of 'handmaiden to history' (*cf.* Noel Hume 1964; 1969; Gilchrist 1994; Moreland 2001).

The use of dominant historical narratives is particularly clear within industrial archaeology, which has traditionally worked within a framework established by economic historians. This has tended to concentrate on the 'archaeological elucidation of the technologies involved rather than the social and cultural parameters' (Johnson 1996, 2), resulting in a discipline 'locked in a technocentric paradigm'(Gould 1995, 49). Consequently, the types of questions that industrial archaeologists have asked have typically been limited to low-level data compilation issues of how many, where and when (West 1999, 5-6) often simply rewriting established historical views (Gaimster and Stamper 1997). This reflects the fact that much of the work undertaken has been small-scale, site based and framed in an historical mode (Palmer and Neaverson 1998, 3). Thus, whilst the careful recording of wear-marks and heat-damage or the scientific examination of temperature and chemical conditions have yielded important information about the processes conducted at industrial sites (see, for instance, Cranstone 1989; 1992; Grenter 1995) it has nonetheless further emphasised the technologies involved and has sought to place the archaeology of industry within a well-established historical narrative.

However, it is ironic that whilst industrial archaeologists have hitherto been content to address issues and themes established by historians it is clear that they have chosen to do so in a highly selective manner for there has been an explicit emphasis on technological and functional analysis. This has perhaps arisen because it is these aspects of the industrial past that are immediately tangible and easiest to identify. It perhaps also reflects the fact that when industrial archaeology developed as an archaeological discipline it looked to industrial history for its periodisation and research agendas and at that time, during the 1950s and 1960s, technological accounts of the industrial revolution were dominant. However, since the mid-twentieth century, historians have begun to break down many of the disabling barriers between social, economic and cultural matters and instead have moved towards a more fruitful and exciting agenda (Johnson 1996, 12). This is true of industrial history, which although retaining a strong economic character, has evolved with an emphasis on industrialisation as one of the major developments in cultural history.

Current trends in historical interpretations of the industrial revolution have stressed the point that the period was characterised by formative changes in the structure of the English economy, the shape of English society and the framework of government (Briggs 2000, 1). Considerable change occurred in the fields of work organisation, finance, commerce, technology, urbanisation, demographic behaviour, agriculture, industry, social life, consumption, leisure, ideologies, labour and labour relations of production (Hudson 1992, 283). Historians have traditionally approached these areas by adopting a number of different interpretative models and these may be broadly expressed as four main explanatory schools of thought: a school of social change; an industrial organisation school; a macroeconomic school; and a technological school (Cannadine 1984, 132; Mokyr 1985a, 3-4; 1985b). More recent agendas have seen something of a convergence of schools of thought and there has evolved a broader, more holistic agenda at the heart of which social and cultural questions have gained an equal footing alongside more traditional economic and technological accounts.

Therefore, and as we shall see in more detail in the following chapter, historians have exercised a far broader interest in the period than most industrial archaeologists and have used the sources at their disposal to establish a highly extensive understanding of the industrial revolution. This thesis contends that if industrial archaeology will allow itself to move towards a similarly broad and exhaustive research agenda it may contribute significantly to existing debate in the field. This does not imply that industrial archaeologists should continue to construct their agendas on the basis of existing work within history. Rather it calls for industrial archaeologists to recognise the wealth of knowledge already amassed about the industrial revolution and to see the potential for similarly extensive research within an archaeological context. Furthermore, it asks that industrial archaeologists do not lose sight of the work of industrial historians in their work, which raises the singularly important question of the relationship of documentary and material sources from the industrial period.

The 'handmaiden to history' debate (*cf.* Noel Hume 1964; 1969; Gilchrist 1994; Moreland 2001) and subsequent studies of the role of material culture and texts has, after a brief divorce (Austin 1991), has led to a convergence in agendas between archaeology and history. This has resulted in archaeological studies within an historical context, sometimes complementary and sometimes contradictory and, in many cases, providing new insights that were not possible within a traditional historical paradigm. For example, Nevell and Walker (1998; 1999) in their *Lands and Lordships in Tameside* and *Tameside in Transition* demonstrated the use of a research agenda driven by archaeological evidence whilst making appropriate use of historical sources to support archaeological interpretations of industry in Tameside. They found that in many instances industrial revolution archaeology could not be reconciled with existing historical concepts or paradigms and that the archaeological data therefore revealed aspects of the past previously unknown from the documentary record. This illustrates succinctly the fact that texts and material can reveal different things about the past. For industrial archaeology this has an important implication. It suggests that archaeological sources have the potential to tell us far more about industrialisation than hitherto realised and that only through a distinctly archaeological approach to industrial remains can that unique knowledge be gained. Those unique insights, however, may be even more illuminating set alongside other, complementary sources, such as the documentary record. This advocates a broadly contextual approach to the archaeological study of the industrial revolution and represents a significant methodological departure within industrial archaeology based upon a framework of inference and a research agenda underpinned by a theoretical content.

2.2.2 INDUSTRIAL ARCHAEOLOGY AND ARCHAEOLOGICAL THEORY

At the same that industrial archaeology began to develop a distinctive identity during the 1960s, mainstream archaeology was becoming more theoretically inclined (Palmer and Neaverson 1998, 3). This amounted to a significant shift in the way in which the archaeological record was interpreted and resulted in challenges to the traditional culture historical approach that had hitherto dominated archaeological thinking (Hunter and Ralston 1999, 6). Consequently, there occurred a pendulum swing within archaeology from a humanities-based to a science-based discipline and archaeological writing 'moved away from straight description to a more hypothesis-based approach applying deductive reasoning to extract the maximum amount of information from the material available' (Palmer 1994, 133). This was termed the 'the loss of innocence' (see Clarke 1973) and seen as the beginning of a series of theoretical developments leading to 'critical self-consciousness'.

However, as a infant sub-discipline, industrial archaeology did not jump onto the theory band-wagon and instead contented itself with data-gathering and description driven chiefly by a conservation ethic. This empiricist stance has endured and until relatively recently it is fair to comment that industrial archaeology has ignored 'almost all theory in some kind of mistaken belief that it could approach the material remains of industrial society with no particular methodological or explanatory framework' (Grant 1987, 118). Industrial archaeology has therefore remained rooted within a traditional and culture historical paradigm, a trait shared with much of the archaeological work dealing with the period after 1500 AD (West 1999, 5).

Recent developments within industrial archaeology (see, for instance, Casella and Symonds 2005) reveal that some practitioners have begun to explore the potential of such thinking in an industrial context. In their seminal work '*Industrial Archaeology – principles and practice*', M. Palmer and P. Neaverson (1998) established the importance of a research agenda suited to examining the social dimensions of production observing that 'the majority of sites in the industrial period provide structural evidence for the social upheaval and redefinition of the class system which accompanied the process of industrialisation' (Palmer and Neaverson 1998, 4). Their argument was illustrated with great cogency through reference to a number of theoretical positions familiar to archaeologists, including Marxism and post-processualism, but the greatest emphasis was placed on the suitability of a 'contextual approach'.

Contextual archaeologists, such as Hodder (1991; 1995; 1997; 2001) and Moore (1985, after Ricoeur 1971) sought to use the model of text as a metaphor for material culture and within this paradigm the archaeological record is seen to encode past cultural and ideological meaning. This meaning is available to be read or decoded by archaeologists through an analysis of the associations and differences between it and other aspects of material culture (Giles 2000, 3). Contextualism stresses the multiplicity of meanings embedded in such material texts and the subjective way in which they would be interpreted by different archaeologists depending on his/her theoretical perspective. Thus, hermeneutic considerations are emphasised within a contextual paradigm and the whole is a position heavily influenced by post-structuralist thought.

Palmer and Neaverson (1998) illustrated the relevance of contextual archaeology to the industrial period. Thus, the obvious 'network of associations' at any industrial site make it particularly susceptible to contextual thinking and within that framework the economic, technological and social dimensions of production may be given equal consideration. This suggests that existing (and traditional) technological or economic interpretations of the period may be reconsidered and used alongside new explanations more concerned with exploring actual working practices, class relations and so on. The crucial element is the stress placed by contextual archaeology on the role of the individual in the creation of material culture and the active role of material culture in society (Palmer and Neaverson 1998, 7-8). This position has been put to limited use by industrial archaeologists. Explicit examples of its application within the context of the textile industries, is provided by the work of Campion (1996; 2001) and Palmer and Neaverson (2001b) who investigated the ways in which the architectural style of workers housing, the buildings associated with out-working, and the spatial layout of worker settlements reflect the nature of the workforce and the attitudes of entrepreneurs. They concluded that the built environment of the industrial revolution revealed the often overt nature of control over production and the workforce. Palmer and Neaverson (2005) made similar conclusions in their broader study of the buildings of the textile industry in southwest England, illustrating with great success the suitability of such an approach by uniting technological analysis, buildings study, documentary evidence, and landscape survey (Nevell 2005b, 245). Crucially, these kinds of study have illustrated the potential for this kind of study to shed light on people and social relations and have shown that those areas are not solely the domains of the social historian (Newman *et al*, 2001, 3).

However, our understanding of contextual archaeology deserves careful consideration. Critics of contextualism have argued that, like processual thinking (which contextual archaeology sought to challenge), contextualism is based on the premise that material culture is a *record* of the past and both assume that this enables archaeologists to make generalising assumptions about the human past (Giles 2000, 3). Some have argued that the concept of the physical and/or textual record is a chimera because it cannot 'capture the actual connection between archaeological evidence and what it is evidence of' (Patrik 1985, 56). Similarly, Barrett (1987; 1988, 6) has suggested that material culture is not a *record* of past events but is rather *evidence* for past social practices. For Barrett, contextual archaeology is concerned with the relationship between social structure and human agency and material culture is understood as 'the surviving fragments of those recursive media through which the practices of social discourse were maintained' (Barrett 1988, 9). This position has resonances with Johnson's (1996) understanding of material culture. For him, archaeological evidence includes any physical evidence, ranging from architecture to landscapes and material goods, and, crucially, any other form of evidence, documentary or otherwise, relating to that physical evidence. This reflects an broader understanding about sources of information about the past, and a post-modernist interpretation which acknowledges that our understanding of the past is limited by the data itself (Evans 1997, 147; Eco 1992; Giles 2000, 4)). These positions are of considerable interest for they recognise that documents and material culture are simply different kinds of mechanism through which particular levels of discourse were structured in the past and provides a theoretical and methodological framework which does not reduce the significance of either source. It is therefore of special interest to archaeologists of the industrial period for it articulates a theoretical position suited to the archaeological elucidation of the social contexts of production whilst acknowledging a role for documentary sources, a wealth of which exists for the industrial period. It is this understanding of contextualism that this thesis will adopt.

2.3 INDUSTRIAL ARCHAEOLOGY - PRINCIPLES AND PRACTICES?

Continued and detailed discussion about future directions in industrial archaeology has led to general acceptance amongst practitioners for the need for a theoretical basis for their research agendas. Indeed, it is only through the implementation of theory that social interpretations of the period can be achieved. Such themes were central to discussion at the *Understanding the Workplace: A Research Framework for Industrial*

Archaeology in Britain conference held in June 2004 and organised by the Association for Industrial Archaeology (AIA) (see Palmer 2005c) and at the *Archaeology of Industrialization* conference in 1999 (see Barker and Cranstone 2004), a joint venture by the AIA and the Society for Post-Medieval Archaeology. These conferences have typ0ified current intellectual thinking and the progression of industrial archaeology from a discipline rooted in a cultural-historical and traditional paradigm to one with a post-processual, post-modern outlook. This would seem to reflect its overall intellectual development 'from consciousness through *self-consciousness* to *'critical self-consciousness*' (Clarke 1973, 6; original emphasis).

However, it is fair to comment that although the intellectual development of industrial archaeology has been the subject of detailed discussion, far less headway has been made in developing methodologies based upon those established principles. Whilst several specifications and published works have established the particulars of approaching and recording industrial remains (*cf.* IARC Working Committee 1981; RCHME 1996; Malaws 1997; Palmer and Neaverson 1998; Badcock and Malaws 2004; Jessop 2005), on the whole these have been concerned with the practicalities of recording field evidence rather than demonstrating any specific research agenda. Consequently, there exists a gulf between the discussion of the intellectual principles upon which future work in industrial archaeology should be based and the practical aspect of archaeological recording in the field. The missing element is the development of a rigorous archaeological research agenda drawing these two elements together. This suggests that, in terms of intellectual development, industrial archaeology actually remains somewhere between *self-consciousness* and *critical self-consciousness.*

Where attempts have been made to develop a distinctively archaeological agenda based upon a theoretical agenda, primarily contextual in approach, the result has been some of the most exciting work and studies of the industrial past. In addition to the work of Palmer and Neaverson (2005; 2001b) and Campion (1996; 2001) on the buildings of the textile industries discussed above (p.31), other notable works in the field stand out. In their study of the industrial development of Tameside, Nevell and Walker (1998; 1999;

see also, Nevell 2005a) established a methodology that accepted a role of documentary research alongside more mainstream archaeological research and the whole underpinned by the recognition that industrial material culture could be used to explore the process of industrialisation with a particular emphasis on the ability of physical remains to elucidate the social dimension of the transition from proto-industry to industrialisation proper. Their methodology sought to link the material evidence with documentary evidence for ownership in order to establish the material expression of different social groups including landowners, industrialists and workers.

Similarly theoretically inclined methodologies have also underpinned a number of smaller projects. For instance, Taylor (2003) developed a methodology based on a modified version of Structuration theory to study the use of industrial sites in Far North Queensland in terms of allocative and authoritative resources as a key to past human agency and the existence of hierarchies and power structures in Australian industrial society. Likewise, Hughes (2004) established a research agenda which sought to integrate more conventional functional approaches alongside a more socially inclined approach to the workers' settlements of the eighteenth and nineteenth century copper industry of Swansea, Wales. His work combined archaeological and documentary research and provided new evidence about entrepreneurial philanthropy in the context of the Welsh copper industry with particular attention to the role of architecture in establishing a new social order.

Other studies have made methodological advances by expanding the sources of information available to the industrial archaeologist, thereby pursuing an agenda integrating archaeological evidence with other sources of evidence. Particularly interesting have been developments in the use of oral history alongside more conventional archaeological and historical sources (see Casella 2005a; 2005b). A similarly innovative methodology has been developed by Robert Young (2002) who has used evidence for vernacular song, in particular those associated with the coal mining industry of Northern England, in order to establish a broader social context for archaeological studies of past industry. Central to his research was the belief that vernacular song and verse is woven into the fabric of everyday life and is potential important in the reconstruction of social and economic relations, self-image, past experiences and the aspirations of the working classes. This expression of shared views has resonances with Bourdieu's *habitus* or a set of generalised schemes of thought, perception, appreciation and action (see Bourdieu 1977; 1990; Jenkins 1992). Young (2002) developed this theory in the context of industrial archaeology, proposing that such sources can be used as a corollary to material evidence in order to establish the social discourse of industrial sites and monuments. Although Young's published work has not, to date, explicitly related the *habitus* expressed in vernacular song to industrial material culture, his work is of interest for it establishes a further source of evidence to be used in conjunction with material sources in the archaeological study of the social dimensions of past industry.

Other recent methodological developments have evolved in a slightly different direction. Symonds (2005a) has argued that an emphasis on material culture as symbolic has restricted an understanding of industrial material culture as physical objects in their own right and has demonstrated through work on the Sheffield steel industry which has sought to interpret material evidence in the context of historical sources but with a greater emphasis on the functionality of industrial objects, buildings and sites. This has a clear resonance with the ideas of Cranstone (2004), who has argued for a renewed emphasis on the technological context of industrial material culture. Whilst this work represents something of a challenge to current thinking in the field, which emphasises the social context of industrial material culture, it reflects a continual development of thinking and, crucially, practices in the field, and it seems likely that future developments in both principles and practice will see something of a middle-ground established between these social and technological agendas. Symonds' work therefore stands out as an important reminder of the need to strike a balance between approaches to the social and technological aspects of industrial revolution material culture, and this is an approach that this research seeks to address.

In summary, the development of research agendas and methodologies within industrial archaeology, which draw on intellectual debate concerning the epistemological foundations of the discipline and have begun to illustrate the archaeological potential of the subject. Crucially, it is the embodiment of those epistemological foundations in recognisably archaeological research agendas that has pushed industrial archaeology forward and has begun to see the expansion of the horizons of knowledge. As it continues to do so, industrial archaeology can expect to be accepted as a credible part of the wider archaeological discourse, raising its popular, professional and academic profile. Central to these developments is the use of a framework of inference based upon a contextual paradigm with an emphasis on the social dimensions of production and with recognition of those social aspects in the context of wider socio-economic and technological change during the period. The remainder of this thesis seeks to develop such an approach and situates itself to implement both a theoretically-inclined research agenda and a methodology for fieldwork. It therefore sees to bridge the apparent divide between principles and practice within industrial archaeology. It will be specifically concerned with the buildings of the Yorkshire textile industries, using that data set as a heuristic device through which to investigate the potential of material culture studies as a means of expanding our understanding of the British industrial revolution and the process of industrialisation between *c.* 1780-1930.

Chapter Three
Towards An Archaeology Of The Factory System

'*The key to the success of the factory, as well as its aspiration, was the substitution of capitalists' for workers' control of the production process; discipline and supervision could and did reduce costs* <u>*without*</u> *being technologically superior*' (Marglin 1976, 48; original emphasis)

'*If meaning in buildings is about relations one should expect to find it in three kinds - between people, between people and knowledge, and between people and things. Ultimately all are social for all are about people*' (Markus 1993a, 39)

More often than not the textile industries have been perceived as the epitome of the story from proto-industry to Industrial Revolution and the rise of the factory system remains a vital pillar in our understanding of the process of industrialisation (Berg 1994a,189; 208; 1994b). Indeed, it is common for the textile mill to be viewed as *the* model of factory-based, mass-centralised production (see, for instance, Trinder 1992; Markus 1993a;). Although the attention paid to the development of the factory within the textile industries has tended to play down the continuing role of muscle power and dispersed manufacturing during the industrial revolution, both within and outside the textile industries (Hudson 1992, 28), the story of the mechanised textile mill continues to play a major part in our understanding of the development of factory-based production.

It has been argued that the major change brought about by the emergence of the factory system of production, and indeed a symptom of industrialisation *per se*, was the increasing separation of the place of consumption (the home) and the place of production (the factory site or plant) (Mokyr 2001, 1). This fundamental organisational and spatial change has proved a fruitful ground for historical research. A major theme for historians interested in the factory system has been the search for the prime mover responsible for the emergence of this distinctive form of production and for the most part this debate has focussed on two polarised schools of thought – technological and organisational accounts of the rise of the factory. In contrast, industrial archaeologists have seldom sought to establish an understanding of the factory system beyond technological and functional imperatives and, as has been discussed above in Chapter Two, have consequently contributed little to wider scholarly debate. However, this need not remain the case.

This chapter will be specifically concerned with framing a new research agenda for the archaeological study of the factory system using the textile mill as a case study. This agenda recognises the need for historical archaeologies to engage with elements of historical debate and to use them to inform new approached to the physical remains of the historical past. It will be argued in the first half of this chapter that many elements of existing historical debate concerning the factory system of production have the potential to frame new archaeological research agendas aimed at understanding the social dimensions of production. Crucially, industrial archaeology is in fact better placed to contribute to some of those debates than traditional historical research, in particular to those models of the factory system based on organisational change and the microeconomics of the firm. The second half of this chapter will examine the potential contribution of existing archaeological agendas to our understanding of the organisational and microeconomic aspects of the factory system, with particular attention paid to those theoretical approaches used and developed by buildings archaeologists, in order to establish a framework of inference upon which the remainder of this thesis will be based.

3.1 THE FACTORY SYSTEM: PERSPECTIVE

Although the rise of the factory system remains a central theme in industrial revolution studies, little consensus has yet been reached concerning what exactly a 'factory' was

(Berg 1994a, 189). On the one hand, this has led to debate concerning the definition of the factory system. Freudenberger and Redlich (1964), for instance, suggested that the factory was defined by concentrations of fixed capital and supervised, organised labour (such as did not occur in domestic workshops) and not by motive power sources. This contrasts with the view of Chapman (1974, 471) who defined the factory-proper as those instances where the technologies of motive power and automatic machinery were organised for flow production. Alternatively, debate has been pitched at a broader level and has sought to understand the factory as one form of manufacturing unit amongst many others. This has resulted in challenges to the idea of the factory as *the* dominant mode of production during the period and instead attention has been paid to examples of small-scale production and 'flexible specialisation' across a variety of industries. These accounts have resulted in a wider understanding of the route taken by industrialisation and emphasised the viability of smaller-scale units alongside factory production, partly because of the unevenness of technological and market development between industrial sectors and partly because of the unsuitability of certain jobs for mechanisation (*cf.* Samuel 1977; Sabel and Zeitlin 1985; Berg 1994b).

Nonetheless, the very existence of the factory system and the fact that it differed from other smaller and often traditionally founded industries, defines it as a fundamentally important part of the story of the industrial revolution. It is the fact of factory-based production, its emergence and subsequent development that forms the focus of this research.

3.1.1 TECHNOLOGICAL ACCOUNTS OF THE FACTORY SYSTEM

It was common in older economic histories of the industrial revolution for changes to machinery and power sources to be emphasised as the prime mover in the development of the factory (Markus 1993a, 261-1; *cf.* Ure 1835; 1836; Ashton 1924; Mantoux, 1928; Mathias 1959; Pollard 1965; Jones 1987). Such technological accounts are epitomised by the work of Landes (1969), who took the view that large-scale technological change was the major impetus for the factory – once machinery had grown too large and sophisticated to be accommodated in smaller, often domestic premises the movement into the purpose-built factory was inevitable.

The technological school thus advocated that technological change was the cause and the factory the effect. For this model the textile industries and the textile mill have proved an enduring case study. For instance, Clapham (1967) noted that by the middle of the nineteenth century the demand of spun cotton began to outstrip supply. This was partly the consequence of a boom in overseas trade, but it was also due to the widespread adoption of the 'flying shuttle' for weaving. This led to a bottleneck at the spinning stage of production. Necessity being the mother of invention, this resulted in the development of mechanised methods of spinning. However, and in turn, this created another bottleneck at the weaving stage of production, which was eventually resolved by the adoption of powered looms. Thus, this model emphasises that the increasing size of machinery during the industrial revolution and the need more powerful sources determined the genesis of the factory system of production.

However, the legitimacy of technological accounts of the factory has been challenged and the fundamental contention is that during the industrial revolution the factory was one of a host of co-existing forms of production. Mokyr (2001, 5) argued that during the industrial period there existed 'mixed systems' in many industries, which incorporated fully mechanised processes and more traditional modes of production. Similarly, Berg (1994) drew attention to the existence of 'dual technologies' and 'flexible specialisation' within and between industries, whilst Samuel (1977, 19-20) showed that many mid-Victorian trades remained divided between mechanised and handicraft sectors. Evidence of this nature is found within the textile industries and poses an interesting contrast to the technologically advanced textile mill. In many of the branches of the textile industries, especially the woollen industry, many stages of production remained hand-powered until well into the nineteenth century. For instance, despite the introduction of the power loom weaving to various branches of the textile industry during and after the 1820s and 1830s it was many decades before weaving by hand was completely superseded, particularly in the linen and woollen sectors (Palmer and Neaverson 1998, 63; Giles and Goodall 1992, 19). Thus the iconic mill, for a time at least, was neither the dominant form of production nor did it truly reflect the organisation of manufacture within the textile industries.

The attention drawn to 'dual technologies' and differing scales of production has fundamentally questioned the pervasiveness of technology as a force for change in the factory system. King and Timmins (2001) attempted to explain the existence of 'dual technologies' during the period. One possibility, they argued was that hand (traditional) and mechanised technologies might have co-existed because powered technology was simply not available for certain jobs, or where sufficient improvements to hand technology had been made and meant, for a time at least, that the efficiency gap between traditional and new forms of steam- or water-powered processes remained imperceptibly low. Alternatively, the persistence of hand and traditional technologies might reflect demand for abnormal or specialist products. In some economic circumstances, traditional technology remained favourable as investment in powered machinery involved a number of risks – high costs, the danger of lending money, and periodic downturns in trade cycles leading to underused equipment, reduction of working hours and financial loans. In contrast, with hand technology fixed costs were relatively low and there was an abundant supply of labour composed of those unable to work in factories, such as the elderly. Furthermore, it must not be forgotten that the attitudes of hand workers and the reaction of the labour force to new technology and the factory system may have, for a time, ensured the survival of traditional working methods, whilst examples of machine breaking and the Luddite are potent reminders of levels of resistance to the new factory system and mechanised production.

In the context of these arguments the immanent logic of technological change and the means by which industrialisation and industrial society occurs is questioned – 'it is a habit of classical thought, and a lesson of experience that mechanization [sic] had as its precondition, capitalism, and as its consequence, mass production' (Sabel and Zeitlin 1985, 174). Similarly, King and Timmins (2001, 68) have suggested that the best-known, but potentially most misleading characteristic of the industrial revolution is the rate at which industrialists adopted powered machinery in place of hand technology. As a consequence, historians have questioned the ubiquity of technological accounts of the factory system and the predominant counterview has argued the importance of organisational change in the rise of centralised mass-production in the factory.

3.1.2 Organisational Accounts of the Factory System

Economic historians and 'New Left' economists have largely developed the belief that the concentration of the means of production at the site of production was the major determining factor in the rise of the factory system. The greatest challenge to technological accounts is the evidence of a number of established centralised workshops or factories before the great inventions of the last third of the eighteenth century (see, for instance, Marglin 1976; 1984; Williamson 1980; 1983; Szostak 1989; 1992; Mokyr 2001). Tann (1970, 3) argued this point through reference to some of the greatest eighteenth century entrepreneurs, such as Wedgwood, Boulton and Gott, all of whom established centralised sites of production at a time when powered machinery could only perform limited tasks in their industries. Similarly, Coad (2001) observed that the Royal Dockyards in Britain preceded the age of the powered process but stand as a fine example of a highly skilled and centralised form of manufacture. These explicit examples have been used to emphasise the suggestion that the rise of centralised production owes more to organisational change than to technological innovation. In other words, it was the benefits of bringing together elements of the production process at a single site and the advantages of a centrally organised workforce that led to the rise of the factory system.

Within this framework a number of positions have been adopted. Some have stressed that factories were introduced for the purpose of exploiting the workforce. For Marglin (1974) the inspiration of the factory was the substitution of control of the production process by workers for control by capitalists, which in most industries occurred prior to mechanisation and actually provided a market for new, powered processes. Thus, organisational change was viewed as an impetus for technological change (Hudson 1992, 28) and technological progress viewed as a by-product of the intensification of social control (Mokyr 2001, 8). It was factory discipline and the supervision of the workforce that were the factors that led to increased output, rising profits and the ultimate success of factory-based production. Within this picture, Clark (1999) has suggested that factory discipline encouraged workers lacking self-control to earn higher wages; the intensification of social control in the workplace is therefore also symptomatic of wider transformations during the period concerning wage trends and the shift from task to time discipline (*cf.* Thompson 1967; Voth 2000).

But we must ask what brought about organisational change in the first place? North (1981) suggested a transaction-cost approach, arguing that the initial impetus for organisational change, and the factory system, stemmed from the merchant manufacturers' desire to monitor the production process more effectively, particularly with regard to ensuring the consistent quality of finished goods. This had been difficult whilst older and dispersed forms of manufacture, such as 'putting-out', were dominant. Likewise, Williamson (1980; 1983) offered an efficiency explanation based on the superior organisational properties of the factory that were quickly recognised and adopted by other industrialists during the industrial revolution. However, Jones (1982; 1983; 1987), using evidence from the textile industries, has stressed that transaction-costs considerations only really influenced the factory system from the second quarter of the nineteenth century by which time the factory was an established form of production. Organisational factors are therefore revealed as highly complicated and it may not be possible to establish a linear development of the factory responding to certain organisational stimuli. We must therefore consider the more subtle nuances of the organisation of manufacturing.

Interest in such subtleties has resulted in attention paid to the rise of the factory and organisational change in the context of the microeconomics of the firm. McDermott (2001) argued that in the factory, and because of the nature of mass production *per se*, each process required a specific type and amount of knowledge constituting human capital on the part of the workers who operated machinery. During the industrial revolution such processes became increasingly sophisticated and consequently the transmission of knowledge became critically important in order to maintain a competitive advantage in a burgeoning market. From the eighteenth century, firm owners began to move workers into factories allowing greater control over the workforce and, critically, over the transfer of information about the manufacturing process (McDermott 2001, 47). McDermott's model also explained that as knowledge increased (which it did so rapidly during the last quarter of the eighteenth century) firms were faced with two main problems: first, how to incorporate existing knowledge, and second, how to remain in the competitive market. For McDermott the factory solved these problems, allowing the transmission of ideas and the retention of knowledge within a controlled, centralised environment. This is a position similarly argued by Becker and Murphy (1992).

Microeconomic accounts of the factory have also emphasised the implications of teamwork and new methods of working. Lazear (1986) analysed the conditions under which a time or piece wage would be paid, noting that a piece wage has a sorting function (for a given output-monitoring cost) so that different employees might receive a wage dependent on their particular job and the quality and quantity of the goods produced. Conversely, the time wage was contingent on the minimum effort supplied, so an obvious choice for factory employees. Jones (1987, 73) noted that hierarchical modes within a workforce that was based at a single site of production offered substantial efficiency advantages because they transferred a set of transactions out of the market and into the firm and it was therefore possible to economise on the cost of transacting. Additionally, Alchian and Demsetz (1972) pointed out that if individual contributions in the production process cannot be disentangled then supervision and monitoring are required. After *c.*1770 they observed that new technology made team production increasingly necessary as factories emerged based on continuous flow production and a plant manager determined the speed of work. For these interpretations, centralised production has benefits and implications for wages, supervision of the workforce and the transfer of information and skills over time through observation and emulation. The acceleration of technological progress placed domestic workers at a disadvantage for the implementation of new techniques was ultimately faster and cheaper in a single plant.

3.1.3 THE FACTORY SYSTEM: A REASSESSMENT

Despite the vigour of historical debate concerning the factory system it is clear that little consensus has been reached on whether the factory developed in response to technological or organisational considerations. Furthermore, neither school of thought adequately explains the persistence of small-scale and often specialised manufacturing units in an environment traditionally seen as progressive and dominated by centralised, factory-based production. Recent research has attempted to address these issues by establishing something of a middle-ground position.

Mokyr (2001), for instance, has sought to establish the underlying motives for the rise of centralised production and the shift away from work in a domestic setting. In the first place he argued that this shift was driven by the emergence of new technologies. These changed the optimal scale of the productive unit and introduced increasing returns were once there were constant returns. As technology and/or processes became increasingly sophisticated the amount of knowledge required by the workforce in order to operate them went beyond the capacity of the household. At the same time, as machinery grew in size, larger plants were established and as they became populated by a large workforce improvements were made to lighting, sanitation, storage control and so on. However, and critically, the rising costs of such provisions and of new machinery meant that fixed costs became increasingly important and as a consequence there was a particular interest in supervising the workforce and microeconomic considerations such as transaction-costs and the transfer and maintenance of knowledge became significant.

Mokyr's model therefore establishes a role for technological and organisational change in the development of the factory and recognises their contribution to the factory mode of production as largely symbiotic and of equal importance (though the exact timing of organisational and technological developments or the impact of one upon the other remains open to debate). It also offers an explanation of why, in some industries and even between sectors of the same industry, there existed different scales of production. In some sectors, technological advances and the benefits of centralised production might have led to factory-based production, whilst in others, the nature of the productive process or market demand favoured smaller scales of manufacturing in which there was no place for technological development and where the benefits of supervising a small or specialist workforce were minimal.

Mokyr's model is also of considerable archaeological interest for it establishes an understanding of the factory which pays equal attention to the role of technology and organisational change. In the main, existing archaeological studies of the factory have demonstrated the close relationship between factory-based production and technological innovation alongside other functional factors such as the development of structural engineering and its implications for factory design. Mokyr's model allows this corpus of work to be complemented by further research dedicated to the elucidation of the archaeological evidence for organisational change. Furthermore, and of considerable importance in the context of this thesis and the intellectual development of industrial archaeology, organisational accounts are principally concerned with an understanding of the factory system in the context of labour relations. They are therefore concerned with the social dimensions of production, the very sorts of issues that have hitherto been lacking from archaeological studies of the period. It will now be argued that through organisational and institutional accounts of the factory that we may achieve a broader understanding of the factory system during the industrial revolution and its social implications. In particular, these models of the factory system engage with a number of historical debates concerning the rise, redefinition and maintenance of class and class relations during the industrial period. Organisational change is therefore especially interwoven with the social dimensions of production.

One of the key characteristics of an institutional approach to the factory is the belief that the factory system offered significant advantages to the mill owner, entrepreneur or capitalist. Central to this tenet is the idea that factory system brought about the substitution of workers' control of the production process for that of the entrepreneur (see Marglin 1974, 46). This implies that, because of the need for supervision and a hierarchical workforce, the industrial entrepreneur had a critical role in determining the development of the factory system (McDermott 2001, 51). Organisational approaches are therefore inherently 'top-down' with implications for our understanding of the relationship between the capitalist and working classes both within and outside of the factory.

Studies of the character of the capitalist and working classes and the relationship between these two social groups, have proved a source of enduring historical debate. Within that exhaustive corpus of literature, a number of key themes are of particular interest to organisational accounts of the factory system, and have the potential to broaden significantly our understanding of the subject.

Entrepreneurial and 'heroic' accounts of capitalists during the industrial revolution have remained popular with historians and it was common for early studies to chart the individual histories of some of the most successful businessmen and firms of the period, for instance, Unilever (Wilson 1954); Wedgwood (McKendrick 1959-60); the Crowleys, ironmasters (Flinn 1962); and Courtaulds (Coleman 1969); Typically, the entrepreneur was given a leading role in the process of industrialisation – they were viewed as the prime mover in innovation and thus the initiator of economic growth during the period (see, for instance, Schumpter 1961; Wilson 1955). This is emphasised by Uglow (2002) who has drawn attention to the inherent tension between innovation, invention and the results of scientific and industrial development as a central characteristic and driving force at the heart of the work of individuals, like those members of the 'Lunar Society' who prepared the way for the modern world:

> 'the excitement of science and manufacturing went side by side with experiments in

> living which aroused horror in the icy evangelical respectability that followed. The Lunar Men shared the praise and abuse together...' (Uglow 2002, xix).

Such models have characterised the entrepreneur as a risk-taking and innovative businessmen who 'practised a stringent personal economy and a rigid austerity, which maximised their savings' (Crouzet 1972, 188). More often than not this heroic view has been set firmly in the context of wider historical models relevant to later European history, such as attributing entrepreneurial asceticism to the strength and tolerance of religious non-conformity in Britain and incorporating ideas about the 'Protestant ethic' and the spirit of capitalism (see Tawney 1938; Weber 1976). Within this approach the factory is viewed as the product of the entrepreneur - a means of establishing a profitable form of manufacture and an outward expression of the entrepreneurial character. These ideas have obvious application to an organisational and microeconomic approach to the factory and begin to go some way towards establishing both the social and economic context within which the factory developed and the motivation of the entrepreneur to adopt and develop the physical form of the factory.

However, these traditional models of entrepreneurial history have been challenged and the focus of research has shifted towards the elucidation of the nature and ideology of the new capitalist and entrepreneurial classes (see, for instance, Bellini 1981; Weiner 1985). Dissenting beliefs amongst the capitalist classes have been attributed to exclusion from universities and political life rather than religious non-conformity. Sweezy (1953) has suggested that far from being dynamic and risk-taking, the entrepreneur was forced to innovate and keep up with competition in fear of elimination in a competitive dynamic that was not of their own choosing. Others have highlighted the fact that political instability and a framework of laws and light taxation favoured British businessmen compared to their Continental counterparts and thus ensured the success of the British entrepreneur and their exalted position in historical accounts of the industrial revolution (Hudson 1992, 22). Furthermore, the inability of the British entrepreneur to respond to changing conditions has been stressed as the main reason leading to Britain's relative industrial retardation in the late nineteenth and early twentieth centuries (Aldcroft 1964, 113). These historical models emphasise a much less favourable, less heroic picture of entrepreneurship but they are equally interesting in the context of organisational accounts of the factory. The need to supervise a workforce, to ensure the transfer of knowledge, and the use of the factory as an outward expression of the character of the individual capitalist. are pertinent to our understanding of changes to the organisation of work during the period. However, in this context they perhaps have as much to do with entrepreneurial élan as the struggle to survive within an increasingly competitive market.

Within these dialogues a further issue is of importance - that of capital formation. This is crucial an understanding of the construction and operation of factories, and is therefore an central theme in the study of the factory system. Models of capital formation have remained a staple theme in economic histories of the period and have been used to explain the existence of the industrial revolution *per se* (*cf.* Schumpeter 1934; Postan 1935-6; Rostow 1953; 1960; 1985; Pollard 1958; Deane and Habbakkuk 1963; Higgins and Pollard 1971; Kuznets 1966; 1971; Feinstein 1971; 1978; Crafts 1983; 1985a; 1985b; Feinstein and Pollard 1988; Richardson 1989), as well as the more detailed study of industrial investment (see, for instance, Hudson 1986; Neal 1994). Particularly germane to this thesis are those studies of capital investment in the context of the factory system. Hudson (1986), for instance, examined the evidence for capital investment in the context of the West Riding woollen industry and found that the problems involved in raising capital to build and operate a factory were at least partially resolved through the use of rented space in larger factories ('room-and-power' mills) and through exploitation of a flourishing second-hand market in machinery and the hire purchase of steam engines and larger machines. This economic environment enabled large-scale factories to be established without significant capital outlay.

The magnitude and sources of capital changed during the industrial revolution. It has been demonstrated that many early factories relied on private credit arrangements, commonly expedited by attorneys. Thus, it was often the case that family and social contacts were vitally important to the industrialist, allowing men of small means to raise capital and to establish factories (Presnell 1956; Cameron 1967; Anderson 1969; Miles 1981). After the 1850s there occurred a shift in the ratio of fixed capital (required to construct and equip a factory) and circulating capital (for wages, stockholding, purchasing and marketing). As companies increasingly made more investment in fixed capital and were able to expand and build larger factories there was a corresponding liberation in circulating capital as productivity rose. This necessarily brought changes in sources of finance away from private and trade credit arrangements and plough-back in favour of partnerships and formal capital institutions such as banks (see, for instance, Feinstein 1978; Hudson 1986; 1992; Feinstein and Pollard 1988). These models are of interest because they not only provide further evidence for an understanding of the conditions within which the entrepreneur emerged during the industrial revolution, but also the economic reality of constructing a factory and operating a textile business, factors that might be expected to reflected in the architecture of the industry.

Of course, organisational accounts not only stress the role of the entrepreneur but also the workforce. Historical studies of the working classes were especially popular during the 1960s and 1970s, reflecting a shift in historical thinking in favour of broader social and cultural interpretations of the industrial revolution. Much of this work took the form of 'history from below', epitomised by E.P. Thompson's *The Making of the English Working Classes* (1969). Discussion has tended to focus on the emergence of the working classes, class-consciousness and radical oppositional politics (see Perkin 1963; Neale 1972; Morris 1979; More 1997; Hopkins 2000) and much of that work has hinged on a set of fundamental questions. Did the working class increasingly exhibit a common consciousness during the industrial revolution and did it recognise that its interests were compatible with those of employers and landowners? Did the working class set about forming associations with the express intention of changing the political and economic system to their benefit? Did the working class become a class 'for itself'? And, did the working class exhibit a revolutionary class-consciousness or were working class agitations largely attempts to gain concessions and to improve the lot of workers? (see Hudson 1992, 33). Consequently, the greater part of work concerned with the working classes has focussed on the evidence for worker discontent (see Pollard 1971) and on the origins and development of worker reform and trade unionism (see Musson 1976; Price 1980; Kirk 1985). More often than not, attention has been focussed on explicit examples of class activity, largely reflecting those actions and events with a high historical visibility.

Alternatively, other studies of the working classes have adopted a more general perspective. Hopkins (2000), for instance, examined the social consequences of industrialisation noting that it was the huge changes to the mode of life that played a major role in the transformation from one that was fundamentally rural to one based largely on industry. To some extent Hopkins work echoed earlier research on standards of living (see, for example, Clapham 1926; Ashton 1949; Hobsbawn 1957; 1963; 1968; Hartwell 1961; 1963; Flinn 1974; Lindert and Williamson 1985; von Tunzelmann 1981; 1994a), but its major thrust concentrated on the period 1830-1951, a period that he characterised as the one in which most of the major social problems resulting from industrialisation occurred, with an emphasis on changes to modes of production, population growth, and demographic shifts.

Such approaches to the history of the working classes are of interest to an organisational approach to the factory and the concept of control within the workplace in two main ways. First, organisational change resulting in the factory was undoubtedly symptomatic of wider social and cultural change during the period. Certainly, the shift towards working in a controlled environment and lifestyles parallelled the development of new methods of flow-production with significant implications for the lifestyle and welfare of workers (McDermott 2001, 48). In this way, the factory may be considered a microcosm of wider social change, with the enforcement of labour relations within the factory (both between capitalists and workers, and between different sectors of the hierarchical workforce) mirrored in a wider social sphere beyond the factory gates.

Second, the factory or workplace was an arena in which groups of workers were brought together on a scale not witnessed in pre- and proto-industrial structures. In so much as the bringing together of workers had substantial benefits in terms of the transfer of knowledge about the production process, it also provided a location within which workers could readily communicate by virtue of being together all of the time. In terms of the existence of a working class consciousness, it is therefore reasonable to view the factory as an environment within which such consciousness could evolve and be propagated. This has implications for our understanding of the rise of worker discontent, unionism and class conflict. It also has implications for strategies of control within the workplace and the extent to which such class unison was allowed to develop within the factory premises by mill owners. In this context, the mill as an arena of control and as an arena for the breeding of discontent are of equal interest.

It is apparent that an understanding of the organisational changes brought about by the evolution of the factory system can be demonstrated to have close links with wider debate within industrial revolution, in particular that concerning the capitalist and working classes. The factory acted as a location in which both these groups came together; the existence of the factory and, in many ways the existence of both social groups, was dependent on a symbiotic relationship laden with inherent paradoxes and tensions. This thesis seeks to understand the role of the factory in this complex social web and contends that a focus on the physical evidence for organisational change and institutional control within the factory offers a means of examining this evidence archaeologically. A means of theorising this approach archaeologically is offered by Closure Theory.

Closure theory, conceived by Weber (1927) and later developed by Murphy (1988) is concerned with the ways in which individuals in society attempt to bolster their position by acting as a group. This is achieved through exclusion and usurpation. Exclusion involves the exercising of power downwards in order to control or restrict others, whilst usurpation involves lower level groups wrestling new rights from the more powerful group. It focuses attention not only competition between social groups, but also within them, and draws attention to three main modes of power, economic, coercive (such as political or military force) and ideological. From an archaeological perspective it is expected that the renegotiation of social position will parallel changing perceptions and beliefs, which, in turn, will be reflected in material culture (Johnson 1993, 6). Rigby (1995) has demonstrated the usefulness of this approach in the classification and categorisation of developments in the medieval economy and society of England, whilst Nevell and Walker (1999) have shown its relevance to an understanding the adaptive strategies of different social groups within industrialising Tameside. Closure theory has obvious resonances with organisational accounts of the factory and is particularly germane to an archaeological understanding of the way in which the factory, as a physical entity, played a role in determining labour and social relations.

In summary, it has been suggested that the movement of workers away from a domestic setting into the purpose-built factory to operate powered processed within a supervised environment was central to, and a defining feature of the emergence of the factory system of production. Furthermore, changes to modes of production affected and were affected by wider social change. The potential of an institutional and organisational approach to the study of the factory as a means of understanding more about the social dimensions of production and its close relationship to many of the socially specific historical models recurrent within industrial history has also been demonstrated. It will now be argued that this constitutes a framework of inference within which industrial archaeology can seek to attain a broader understanding of the factory system, allowing socially meaningful interpretations to be made of the physical remains of industrial revolution factories.

3.2 THE FACTORY SYSTEM: AN ARCHAEOLOGICAL AGENDA

In essence, the factory system, as it is understood by scholars like Mokyr (2001) and McDermott (2001), represents a basic spatial change. Not only did the rise of the factory result in the movement of many workers into a purpose-built working environment that was distinct from the domestic setting, it also resulted in a spatially-distinctive environment within which production took place and the skills associated with manufacture were learnt and transferred. From an archaeological perspective, this spatial change is of great interest.

Ironically, however, the two notable examples of the study of the factory as a distinctive spatial and social phenomenon have emerged outside of the field of archaeology; one from within architectural studies and the other from within art history.

The work of the architectural theorist John Peponis (1983; 1985) was explicitly concerned with the 'spatial culture of factories'. Inspired by an increasing number of studies devoted to management theories and organisational explanations of modern workplaces, primarily the rise of the office environment, Peponis explored the effects of the organisation of the workforce, and the social effects of different layouts in the factory. Central to his work was the desire to establish the ways in which the spatial form of the factory (which was perceived as a distinct spatial phenomena) reflected ways of working with a particular emphasis on the opportunities it created for a hierarchical workforce and the control of labour.

Peponis' research was based on six case studies selected on the basis of obtaining as varied a sample as possible, in order to search for general principles governing the spatial aspects of factory design, whilst also allowing a detailed examination of the precise influence of spatial variables on factory cultures. The choice of case studies was also determined by practical limitations, such as access to sites, the technological systems that the factories employed, and the desire to study pairs of factories using the same technologies of batch, mass, or process production. Accordingly, the chosen case studies included three factories in Greece and three from Britain (Peponis 1985, 363-4).

Central to Peponis' research was the analysis of space in the factory complex using the principles of space syntax analysis developed by Hiller and Hanson (1984; a detailed discussion of this analytical technique can be found below in section 3.3.3). This analysis was supplemented by interviews with employees and managers at each site in order to establish a background of 'qualitative data' against which the spatial aspects of the factory could be interpreted (Peponis 1985, 365). Peponis concluded that the status of workers in the factory environment constituted spatial categories based on segregation achieved through the imposition of boundaries which impeded direct access between areas of the factory inhabited by people of different status. This segregation was found to have been achieved without destroying the flow of the production process or the technologies involved. Peponis also observed that supervision largely reflected the position of machinery allowing circulation around the factory floor, but that supervisors also primarily inhabited spaces separate from the main working areas, but from where other workers of a lower status could be easily observed. Thus, the 'fine tuning' of factory design presented a problem in terms of allowing supervision but also maintaining an element of segregation establishing hierarchical labour relations. This, Peponis observed, was largely achieved through communal rest areas set aside for supervisors, which served to bolster their position and natural affinity as a group within the workforce. Furthermore, he observed that chances for 'encounter' between different elements of the workforce were dealt with in one of two ways: either co-presence was permitted or prevented. Peponis argued that this did not result in two different forms of factory, but rather highlighted the way in which factory design accounted for the opportunities of encounter and enmeshed them with the properties that affect the exercise of control and the differentiation of category, based on status within the workforce. Thus, encounters between different workers may be allowed where the level of supervision was high, resulting in a high degree of control without maximum segregation, and, conversely, spatial segregation may be implemented where supervision was less prominent. In the latter case, the opportunity for a strong sense of identity and status between workers, and the creation of territories defined by status, was greater.

Whilst Peponis' work is of interest to this thesis, it is largely descriptive and produced from an architect's perspective with a view to informing the design of future factory buildings. Its main aim was to considered the possibilities of interaction between workers within the factory and how this could be regulated or encouraged from a management point of view and integrated into modern factory design. Peponis' research is therefore firmly situated within architectural research and no attempt was made to project the findings on to past examples or to explain the role of the space in the genesis and initial development of the factory. Ultimately, therefore, his work offers a tantalising glimpse of the possibilities of a spatial understanding of the factory and its organisational, institutional and social implications, but does not seek to establish the underlying social factors or wider social and cultural context of the labour relations he observed. Nonetheless, these ideas are stimulating and their potential contribution to an understanding of the factory in the past should not be underestimated. In particular, many of the ideas concerning labour relations, hierarchies, and the imposition of control over a workforce are germane to this thesis and have parallels with some of the issues raised in the first part of this chapter, particularly those concerning class identity, the relationship of the working and capitalist classes and the organisation of labour and social relations.

The desire to understand underlying social and cultural factors inherent in the emergence of post-medieval architecture was, however, central to the seminal work of T.A. Markus in his influential work *Buildings and Power: Freedom and control in the origin of modern building types*. Markus (1993a) sought to identify and examine the forces leading to the development of new building types during the eighteenth and nineteenth century. For him, the key building types that emerged during this period fell into three main categories – those that controlled relations between people (schools, institutions, assembly rooms); those that reproduced knowledge (museums, art galleries, libraries); and, those used for production and exchange (markets, factories shops). Central was the desire to explain the emergence of these new building types in terms of social and cultural pathologies of order and meaning, shifting the focus of architectural debate away from the dominant themes of art and technology towards an analysis rooted in the social significance of architecture. Markus' work is therefore particularly germane to the broader intellectual project of this thesis.

Markus' work on the factory is equally relevant. For him, the factory represented the most revealing industrial forms in terms of organisation and space, providing evidence for the close connection between buildings and social relations. Furthermore, Markus defined the evolution of the textile mill as the archetypal factory. Inherent in the factory, Markus identified three defining structures: social, spatial and power transmission (1993a, 264). Within this paradigm, he revealed the close relationship between technological factors (including the machinery, the layout of processes, power generation, and the means of power transmission) and social aspects (including the movement of the workforce, and facilities for the workforce, such as sanitation and heating systems) in the mill. These structures were seen to not only define the factory, but their evolution over time to the point where, in the fully-developed factory, they were homologous and could be mapped exactly on to each other. Thus, Markus, like Mokyr (2001) and McDermott (2001) viewed the factory in terms of a fundamental spatial change, but it is in his work that the relationship between the physical form of the factory and technological and organisational change is made explicit.

Therefore, for Markus, the form of the factory, epitomised by the textile mill, grew logically from the inherent three structures like a soap bubble, each structure determining the physical character of the mill building (1993a, 266). The factory was seen to have responded to the development of new sources of motive power, with the advent of steam power resulting in the need for new structures like engine and boiler houses that had not been necessary when waterpower was pre-eminent. Similarly, developments in the means of transmitting power throughout the factory, such as line shafting and, later, rope drive systems, resulted in a host of architectural solutions designed to allow power to be transmitted throughout the mill in the most efficient manner. Likewise, Markus drew attention to the increasing size and sophistication of machinery during the industrial revolution and the growing size of mills, particularly after the early nineteenth century. Of course, there was something of a reflexive relationship between the need to house larger machinery and developments in structural engineering which allowed larger, and often fireproof factories, and between increasingly sophisticated processes, more powerful sources of motive power, and efficient means of power transmission (1993a, 264-286).

Added to this complex technological and spatial nexus, Markus focussed on the social elements of the mill. On the one hand, he pursued a rather literal approach, with attention paid to increasing sanitary provision, heating, and the movement of people and goods (1993a, 280-81). Alternatively, though not unrelated, Markus was also interested in the ways in which the form of the factory facilitated the supervision of the workforce. Thus, and of course, bringing together his three structures, Markus demonstrated that the design of the mill supported the existence of a hierarchical workforce – it was a bounded space, usually only accessible from a single point, and a space in which workers were, by virtue of the layout of machinery and their location in a specific part of the mill determined by their individual job, were committed to labour regulated by overlookers and supervisors and the fact of continuous production.

However, Markus 'all too quickly reverts to straight historical analysis' (Palmer and Neaverson 1998, 7) and becomes vague and generalising. Where Markus discusses the organisational aspects of the factory the greatest emphasis is placed upon the physical layout of machinery with only a passing mention of the distribution of workforce in the mill and the inherent labour hierarchy at the expense of a broader discussion of various advances in powered machinery, patents, and inventors. Similarly, his discussion of the 'spatial systems for the movement of people' (Markus 1993a, 280) within the mill quickly moves from a social perspective to a consideration of the impact of advances in structural and mechanical engineering on such apparatus as lifts, hoists and systems of heating. The result is a fairly orthodox dialogue with the greatest emphasis on structural engineering and technological change. This is borne out by Markus' closing comments on the textile factory:

> 'In it we can see the most striking feature of the factory system: the reorganisation of space to exploit and machinery and power sources in a new social system' (Markus 1993a, 284)

Part of the problem, perhaps, is that Markus' discussion seeks to place the factory and mill in the context of buildings associated with production and exchange, divorcing them from his discussion of those building types designed to control people and social relations (such as institutions and schools). Such a division is ultimately unhelpful.

Markus' work also bears out another major and crucially important issue. His work is, to some extent, compounded by the nature of the sources used. For the most part, Markus' work is based on documentary research and physical examples are included as a means of illustrating historical examples. As a consequence, he only really addresses those elements of his three structures that are readily identified from historical sources. This creates a bias which favours a discussion largely based on technological innovation and structural engineering, for which plans, historical images, and descriptions (for his case studies at least) were abundant. The main point is this. Whilst Markus appears to offer an explanation of the factors that determined the form of the mill, he does so largely without recourse to substantial physical evidence. Consequently, he does not fully explore the social and organisational issues that he views as integral to the factory and its development through time and space, but instead favours those aspects of the mill that are historically tangible.

The work of Peponis and, in particular, Markus demands reconsideration, but within an archaeological framework and with a renewed examination of the social aspects that both these authors argue are so much a part of the factory and factory system of production - namely labour and social relations. During the remainder of this thesis it will be demonstrated that archaeologists, particularly those concerned with the archaeology of standing structures have developed theoretical models which seek to examine the relationship between built space and social agency. Underlying these models is the premise that buildings and architectural space, like other forms of material culture, are active in the creation, maintenance and reproduction of social relations. The following discussion seeks to explore the possibilities and constraints of such theory within an archaeological context, with specific attention paid to its potential contribution to the archaeological study of the social dimensions of production in the context of the factory system and the textile mill. Furthermore, its relevance to the development of industrial archaeology as a discipline will be demonstrated, in particular the role of material culture studies in social interpretations of the industrial revolution period.

3.3 The Social Logic of Space

In an obvious way, buildings are social phenomena. They convey meaning through the use of decorative embellishments and overall architectural style and through their internal spatial organisation (Markus 1993b, 15-16). The recognition of buildings as social objects has led to a range of theoretical models and frameworks being developed designed to examine the ways in which buildings fulfilled their social function. Much of this work has been developed within building studies, anthropology and sociology, but has also found ready application within buildings archaeology. In the latter field it has developed in two principal and complementary directions: the application of social theories, and the formal analysis of space (Grenville 1997, 16).

3.3.1 Social Theories of Space

Lefebvre (1991) considered space to be a social product, suggesting that material space was inextricably related and intertwined with pathologies of order and meaning understood by society. The structuring of space incorporates a number of different elements and structuring principles and this is one way in which humans categorise, classify and make sense of the world (Humphrey 1984, 143-5; Aspinall 1993; Dovey 1999). Through this classification order is imposed on the world, which is not simply an ordering of everything in its place but also an ordering of morality, social relations, space, time, and the cosmos (Parker Pearson and Richards 1994, 10; 38; Foucault and Rabinow 1993). In terms of architectural space this occurs because the built environment arranges people in existential space – it locates them in relation to each other, engendering encounters and patterns of movement between different individuals and groups. Furthermore, this relationship is reflexive because humans not only interact with the built environment, but certain groups or individuals can change or re-enforce the arrangement of space through building types, boundaries, paths, markers, zones and so on.

Naturally, archaeologists have been interested to explore these possibilities within the built environment, and much of their work has been set within structuralist framework, inspired by the work of linguists such as Saussure (1959) and Chomsky (1964). Crudely expressed, the structuralist paradigm is primarily concerned with the ways in which the arbitrary relationship between words and the meaning that they convey is established through an accepted system of signification which allowed communication to occur (Tilley 1990; 1998; Hodder 1991; Giles 2000, 1). This has been adapted for use within archaeology through the idea that material culture has meanings, which although not overtly expressed, operate as a system of signification for a particular culture in the past. Extended to the built environment, buildings and architectural space are seen as an expression of culture in which mental structures and processes are deeply embedded (Giles 2000, 6). The role of the archaeologist is therefore to identify the systematic relationships between different aspects of the built environment in order to reconstruct past cultural and social systems (Lawrence and Low 1990, 466).

These linguistic metaphors have been used to approach buildings by archaeologists (see for instance, Harris 1989; Lawrence 1987; Douglas 1966). Many of these studies have drawn explicitly on the work of structuralist anthropologist Levi-Strauss and have been specifically concerned with the way that human minds categorise information based on unconscious mental structures and expressed in terms of binary opposites (Leach 1973; Giles 2000, 6). In terms of the built environment, such, these binary opposites might be light/dark, male/female, sacred/profane, inside/outside, high status/low status, and so on. These have been used to link observable patterns in houses to universal systems of thought within societies. Lawrence (1987), for instance, has shown how sets of oppositions may be articulated in the house plans of mid-twentieth century English house and demonstrated that they conformed to a set of underlying social and cultural codes or rules, expressed as binary opposites (front/back, clean/dirty, public/private, male/female) (Parker-Pearson and Richards 1994, 8). Similarly, Douglas (1966) has used the idea of binary opposites to explain the existence of deeply embedded and symbolic structures related to the concepts of order and pollution within the wider environment (Giles 2000, 6).

The idea of 'generative grammar', borrowed explicitly from the work of linguistic theorist, Noam Chomsky, has also influenced archaeological approaches to architectural space. The identification of a grammar has usually been based on formal analysis in which patterns of association between different elements are recognised and measured (Mytum 1989, 345). Thus, Henry Glassie's *Folk Housing in Middle Virginia* (1975) was concerned with the 'syntax' encoded in the built form and spatial organisation of American vernacular houses and demonstrated the existence of a variety of 'rules' that applied to the design of those houses. Those 'rules' or 'syntax', and changes to them, were seen to reflect shifts in underlying cultural and ideological systems, which were interpreted as growing 'Georgianisation' within American society. Likewise, Deetz (1996) used the idea of a generative grammar to investigate the ways in which those same cultural and mental shifts associated with 'Georgianisation' were reflected in a wide range of material culture.

However, many of these models have remained largely descriptive and whilst they have been concerned with the material mechanisms through which social relations were generated, maintained and altered over time, they have not explicitly theorised the crucial relationship between human agency and social structure. Such theory is, however, offered by Gidden's theory of structuration and Bourdieu's concept of the *habitus* (for comprehensive overviews of these positions see Grenville 1997; Giles 2000).

3.3.2 STRUCTURATION AND *HABITUS*

Giddens' structuration theory and Bourdieu's idea of *habitus* have proved highly influential in anthropology and sociology, and likewise have proved popular as a theoretical framework within archaeology (see, for instance, Barrett 1988; Graves 1989; Gilchrist 1990; Johnson 1993). Developed from Giddens' (1984) critique of the social theories of Marx, Durkheim and Weber, structuration theory provides a means of thinking about how society and social knowledge are reproduced over time (Giles 2000, 9). In essence, structuration theory is underpinned by the idea that there is a recursive relationship between social structure and social practice (Samson 1990, 14; Hodder 1991, 74; Johnson 1994, 104). This is the concept of 'duality of structure', the means by which 'social structures are both constituted *by* human agency, and yet at the same time are the very *medium* of this constitution' (Giddens 1976, 121; original emphasis). Social structure is therefore seen as both the means and the outcome of a process of structuration – the production and reproduction of social practices across time and space.

Structuration theory rejects the idea that time and spaces are passive categories. Rather, space is understood as a medium through which social relations are produced and reproduced over time (Gregory and Urry 1990, 3; Giles 2000, 10). Thus, all social action is seen to be situated firmly in time and space (Foster 1989, 41) and social structure is entirely spatially contingent on the context of the presence or absence of human actions and the social practices in which they are engaged (Soja 1985; Pred 1990, 119).

These ideas are complex and in order to theorise them succinctly Giddens developed the concept of the *locale* – a physically bounded space providing a setting for 'institutionally embedded social encounters and practices' (Giddens 1979, 206-7; 1981, 39; 1984, 118-19). Central to the idea of the *locale* is the belief that the environment exists in terms of human action and space – it is existential space that is neither external object nor internal experience. Architectural space may be conceived as the concretisation of existential space, by transforming it and delimiting it (Norberg-Schultz 1971, 2; Parker Pearson and Richards 1994, 4). The *locale* therefore focuses attention on the material settings of human interaction, the social practices occurring within it, and, crucially, the recognition of its social meaning by the people involved (Giddens 1985, 271). In the context of this thesis the principal *locale* could comprise the factory or textile mill.

Within the *locale*, Giddens highlighted a degree of 'regionalisation' (1984, 110). This concept is based on the zoning of social practices according to their spatial extent and temporal depth in relation to routinised social practices and largely derives from the work of social geographers such as Hagerstrand (1978) and sociologists such as Goffman (1959; 1961; 1967) (Giles 2000, 10). A major emphasis of 'regionalisation' is the corporeality of the human body as a factor imposing constraints on an individual's occupation of time-space. The level of 'presence-availability' of the individual body dictates the potential for social encounters (or 'co-presence' – the opportunity for human actors to come together) and thus the regionalisation of the *locale*. In this way, regionalisation contributes to the structuration of social systems by 'zoning' space into 'front' and 'back' regions (Giddens 1984, 122-3). Here there are explicit parallels with Goffman's (1970; 1961; 1959, 109-40) theorising of the social interactions of embodied individuals into 'frontstage' (public) or 'backstage' (private) regions, articulating an understanding of human interaction as a 'performance' or a 'game' governed by rules that act as resources through which individuals seek to achieve ontological security. Giddens emphasised that the two main axes of regionalisation ('front' and 'back' spaces) managed a complex nexus of relations between meanings, norms and power (Giles 2000, 10), thus mediating the interaction of different individuals or social groups using the same building as well as creating and maintaining the power structures inherent within those social relations.

Despite the apparent usefulness of structuration as a framework through which to understand the complex issue of social practice, Giddens fails to fully explore the material structuration of the *locale* or its regionalisation over time (Barrett 1988, 8-9; Giles 2000, 10), largely because Structuration theory was never developed to explain change over time (Samson 1990, 15). Consequently the work of sociologist Pierre Bourdieu (1977; 1990; Jenkins 1992) is of particular interest for his theory of social practice was explicitly developed in relation to material culture and the use of space (Hodder 1991, 74).

Central to Bourdieu's work is the concept of the *habitus* - a habitual state or condition situated between social structure and social practice. It represents durable systems of transposable cultural dispositions through which individuals gain an understanding of 'how to go on' in social life (Giles 2000, 10). That knowledge is understood through 'strategies' – improvisatory and performative forms of social practice (Jenkins 1992, 39). *Habitus* is considered to be neither wholly conscious nor unconscious and exists through embodied, routinised social practices. For the 'actors' involved this behaviour is entirely context dependent, strategic and practical. This emphasises the physical presentation of the human body or bodily 'hexis' as the mechanism through which *habitus* is imprinted on the individual and the process of learning or socialisation (Barrett 1987, 87; 93-4). Critically important then is practical logic and knowledge (Hodder 1991, 74).

Bourdieu conceived two distinct forms of *habitus* – the *habitus* embodied by individuals and collective *habitus* (Bourdieu 1977; Jenkins 1992, 80). The first is acquired through personal experience and socialisation and is reflexively adjusted over an individual's lifetime in relation to objective reality. The second is a shared body of generative schemes and cultural dispositions, which form a collective and homogenous phenomenon uniting particular social groups, amounting to common behaviour and a consensus of meaning (Giles 2000, 11). The homogeneity of *habitus* therefore occurs through the judgement and assessment of the effects of what the self and others have done (Hodder 1991, 75). Critically, the objective world and the material world are understood as the product of past experiences and social practices. This has been argued to be a dialectical relationship between the collective history inscribed in objective conditions and the *habitus* inscribed by individuals (Jenkins 1992, 80). In this way *habitus* is passed from generation to generation without going though discourse or consciousness (Hodder 1991, 75). It is this process of enculturation that is of interest to archaeologists for it is by this mechanism that material culture is intrinsically linked to social structure. Furthermore, as it continues to descend through the generations, the *habitus* continues to play an active role in social action and is also transformed by those actions; it therefore has recursive properties that parallel Giddens' 'duality of structure'.

Bourdieu further argued (1990, 271-83) that a sense of self-identity is encultured in an individual through a process of 'symbolic interaction' with the material framework within which particular aspects of material culture have cultural significance. This includes the spatial arrangement and partitioning of buildings, their moveable fixtures and fittings, and the artefacts used within them during particular activities and rituals (Giles 2000, 11). Material culture can therefore be understood as one aspect of the cultural resources over which struggles or manoeuvres take place within a particular arena or 'field' (Jenkins 1992, 84) and in this way material culture plays a major role in the process of enculturation, in forming the social world (Hodder 1991, 76).

The concept of the 'field' has played a central role in the development of Barrett's (1988) concept – 'fields of discourse'. Barrett (1988, 10-11) used the term 'field' as a heuristic device to analyse the ways in which social practices occupy time-space, and is an archaeological example of the use of the work of Giddens and Bourdieu that develops a critical understanding of the relationship between the human body and social practice and the interaction between the human body and architectural space. Fields are understood as defined by their tempo, their spatial extent, the cultural resources required to define them, and the transformations that occur as the field is reproduced (Giles 2000, 11). Examples of fields include political or economic conditions, ideological beliefs and specific historical episodes, for instance, the Reformation or the Industrial Revolution.

Barrett's archaeological application of the work of Gidden's and Bourdieu is of considerable interest to this thesis. In the context of his work, the industrial revolution not only forms an over-arching field of discourse, but within it is the potential to study other, more specific 'fields', including the re-definition of social groups, class ideologies and fundamental changes to the means of production during the period. The factory may therefore be seen as one *locale* within which these fields were played out. The physical remains of industrial revolution factories, most obviously the textile mill, thus invites a critical examination of these fields, of the principles underlying social practice during the period, and the role of material culture in structuring and maintaining that practice within the *locale* of the factory.

3.3.3 FORMAL SPATIAL ANALYSIS

The form of a building produces a powerful experience – it conditions the character of a building and the way that those who enter and use it perceive it. Frankl (1968, *vii*) noted that form has three main components – the geometry of space, mass and surface techniques (the actual material which forms space – 'physiognomy'), and optical phenomena including the effects of light and colour, which coalesce in the mind to create a particular sensation. It is the combination of these formal attributes that help to provide meaning about the world, a view derived from *Gestalt* psychology (see, for instance, Koehler 1966). In the majority of cases the meaning that these formal attributes impart reflects a conscious decision on the part of the builder, architect, owner or patron to make such statements – they can therefore be used as a contrived means of establishing particular meaning in a given place or architectural environment.

These ideas have been developed further through the idea of embodiment theory in which the body is seen as a form of physical capital which facilitates access to particular economic, society and cultural resources (Bourdieu 1977). The relationship between the body and social status is seen to be reflexive and dependent on the presence of substantial inequalities in the symbolic value accorded to particular kinds of body within particular societies (Giles 2000, 12). Crucial is the understanding that power resides with those dominant social groups who are able to define or construct their bodies as being socially superior to others and to impose particular kinds of bodily identity on others (Shilling 1993, 140). This has resonances with Closure theory (see, for instance, Murphy 1988) and the idea that social groups will attempt to bolster or alter their social position through economic, coercive and ideological power, all of which may be expressed through material culture, including buildings.

These kinds of interpretations of the built environment have played a central role in the development of formal spatial analyses. Important is the idea that the configuration of space within a building formalizes and frames social action (Grenville 1997, 17).

Buildings are therefore seen to represent enclosed spaces or sub-divided cells within which social action takes place. Consequently, the nature of that space largely determines the type of social action that is carried out.

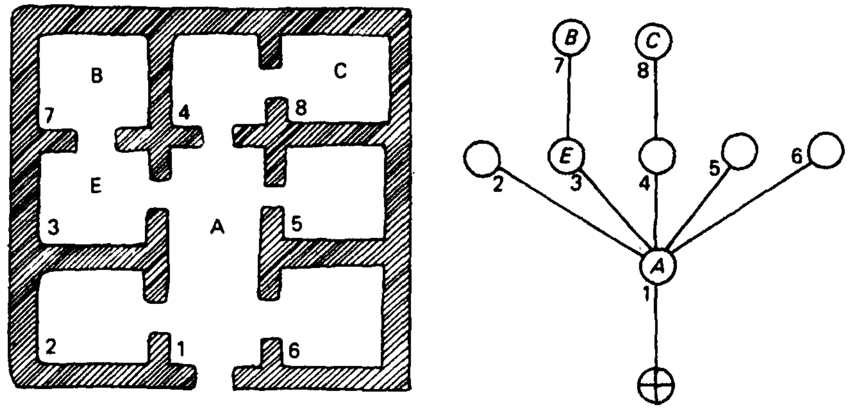

Plate 4 *Example of access analysis: simple building plan and its gamma map (after Hillier and Hanson 1984, 151)*

The work of Hillier and Hanson (1984; also see Hillier 1996; Hanson 1998) has been hugely influential in the development of formal spatial analysis and is based on the idea of a spatial grammar or syntax. They have argued the existence of an explicit relationship between spatial form and social structure. The underlying belief is that by mapping the space through a technique known as 'gamma' or 'access analysis' or 'gamma analysis' a diagrammatical representation can be created of the system or social relations within a building based on access routes running through it and connecting its component spaces (Plate 4). By mathematically justifying the resultant 'gamma maps' the symmetry or asymmetry of spatial organisation is interpreted from the space syntax by analysing the importance of a given space in terms of its degree of separation from other spaces, and its distributedness or non-distributedness similarly analysed by examining the means of access to a space and its boundaries (Hillier and Hanson 1984; 148).

The observed spatial patterns are taken to be a direct reflection of social organisation. Central is the idea that the spatial qualities of the building exist in terms of two categories of people: 'inhabitants (for instance, the owner or their representative) and 'visitors' (inmates, visitors, etc.). The former have an investment of power while the latter are the controlled (Markus 1993a, 13). Through the possibilities of interaction and access within the building and between these two groups, the spatial configuration maps out the wider organisation of society. Thus, there is an implicit assumption that areas that are easily accessible have a more public role than spaces deeper within a spatial system, which may be described as private. Furthermore, the particular ways in which a space may be accessed are central to understanding possible movement and opportunities for human encounters within the structure as whole. It is these spatial qualities that are seen to control human actions and, as a consequence, to reflect the organising principles of society. Different spatial configurations clearly have inherent variant qualities, a set of which may be considered to constitute the generic rule underlying the spatial form in question. This is referred to in a broad sense as the *genotype* of the building or site, though individual examples will undoubtedly have a different *phenotype* or actual realization of these rules (Hillier and Hanson 1984, 174-75; Foster 1989, 42; Hanson 1998, 32) and this allows the nature of the organisation of society to be understood.

By establishing the syntactic properties and genotypes of spatial structures, Hillier and Hanson sought to illustrate that society is organised in a way that, in the material world is embedded in space. That social organisation was perceived to exist in two main forms: organic solidarity and mechanical solidarity. Here are explicit parallels with the work of Durkheim's (1964; 1982) theory of 'organic' and 'mechanical' societies. Organic solidarity consists of mutually interdependent relations in which everybody has a role. This is often expressed through hierarchies and as such tends to be closely related to space. Mechanical solidarity reflects the relation between people, often equals who share a similar ideology or existence, and may be trans-spatial. Individuals may participate in both types of solidarity to a lesser or greater extent, a classic example being a factory worker who experiences organic solidarity as part of a hierarchical work force but also experiences mechanical solidarity through a strong affinity with other members of the working class and, perhaps, as a member of a trade union. Protagonists of spatial analysis, like Hillier and Hanson, suggest that the generic principles of spatial configurations allow these elements of the organising principles of society to be observed and something to be said about whether a building is designed to control, establish hierarchies, unite or engender communal behaviour.

However, the use of space syntax analysis has encountered criticism (*cf.* Batty 1984; Leach 1978) and the major contention is the underlying belief that 'spatial organisation is a function of the form of social solidarity – or the organising principles of social reproduction – in that society' (Hillier and Hanson 1984, 143). Caution has been expressed at the view that there exists some sort of one-to-one law-like relationship or cross-cultural uniformity, between spatial patterns and social realities (Grenville 1997, 20; Brown 1990, 103; Foster 1989, 43). This has led some to consider that the chasm between basic space syntax and real life sociology is wider than Hillier and his colleagues suppose (Leach 1978, 400) and one must question whether space syntax analysis simply falls into the realm of the analyst playing with patterns and always finding something that fits (Hodder 1991, 39). Furthermore, Robbins (1995, 88) has argued that the techniques proposed by Hillier and Hanson (Hiller and Hanson 1984; Hillier 1996; Hanson 1998) are so totalising and tendentious that the reader is not allowed any intellectual negotiation and *must* accept them which tends towards confusion rather than clarity and more questions than answers about the relationship between social practice and space.

These reservations have led some to conclude that Hillier and Hanson's attempt to bridge the divide between spatial form and social process is 'rather inconclusive', particularly where it has been applied to archaeological data (Batty 1985, 162). Thus, whilst ethnographic examples (for instance, see Yiannouli and Mithen 1986) have indicated that observed space syntax are not coincidental and can be explained in social terms, there is no such supporting evidence for archaeological data from many periods. Consequently, Leach (1978, 388) has argued that Hillier and Hanson's technique cannot work unless something is already known of the relevant society, at which point it can be seen in retrospect how the observed patterns in spatial arrangement relate to known social structure. However, for periods where comparative ethnographic material (such as prehistory) or historical sources (such as the industrial period) exists, some of these concerns are, at least, partly addressed.

However, 'as a means of providing new insights in to the social use of space, access analysis has much to recommend it' (Grenville 1997, 20) and the work of Hillier and Hanson has been considered unusual, stimulating, thoughtful, and with great potential for the study of the social dimensions of the built environment (Batty 1985, 162; Richardson 2003, 383). Its greatest strength is perhaps its visual representation of space and its ability to allow those observations to be quantified. A number of archaeologists have been inspired to use access analysis (principally as a methodological procedure) alongside other analytical procedures in order to avoid some of the generalising tendencies of space syntax and to establish the ways in which architectural space framed social action. Fairclough (1992a; 1992b), for example, combined access analysis with planning analysis, a technique originally developed by Faulkner (1958). Planning analysis produces diagrams designed to reveal the 'mode of living' of inhabitants and are used to emphasis the ways in which the status of social knowledge or an individual affected their use of architectural space. Fairclough also examined the iconography and symbolism of architectural fixtures and fittings, emphasising the ways in which these may affect patterns and movement within a building. Access analysis has also been used to study notions of social privilege and privacy in the medieval town and Cathedral Close of Salisbury, Wiltshire (Richardson 2003) (Plate 5).

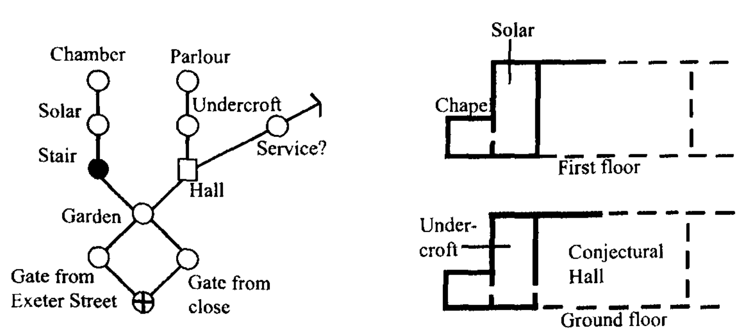

Plate 5 *Access analysis applied to the Bishop's Palace, Salisbury (after Richardson 2003, 378)*

The technique has also been applied to other periods. Foster (1989) used access analysis in order to study the houses and settlements of the Scottish Atlantic Iron Age, but modified the technique by using it in conjunction with other evidence for architectural form and social function. Foster's work therefore sets access analysis within a broader context, establishing its relationship to structuration theory, the work of Bourdieu (1977; 1990), and Barrett's (1988) concept of 'fields of discourse' by emphasising that architecture is culturally meaningful and that architectural space is both produced by, and in turn, produces and reproduces social relations, and that all social action is situated in time and space. Ultimately therefore, Foster's study follows a contextual rather than a structuralist approach with particular parallels with Barrett's (1988; 1988) understanding of contextualism, which emphasises that active human agents reproduce the material conditions in which they live and in doing so employ particular cultural codes in their discourse which they are known to reflexively structure the knowledge that humans can possess. It therefore follows Barrett's (1987, 1) argument that contextual archaeology should be concerned with the ways in which particular material conditions structure and maintain specific kinds of discourse and thus particular forms of knowledge and power.

3.4 THE FACTORY SYSTEM: TOWARDS AN ARCHAEOLOGY OF CONTROL

The appropriateness of applying a contextual approach to the archaeological study of the factory is therefore recurrent: it has already been demonstrated as a means of providing a theoretical foundation within industrial archaeology as a discipline, providing a means of integrating historical and physical data within an archaeological research agenda. It also offers a means of understanding the social logic of space in buildings, integrating theories of the relationship between human agency and social structure, and formal spatial analyses. In the context of the current discussion, the relevance of a contextual approach to social interpretations of buildings of prime interest.

The idea that material conditions, such as buildings, structure and maintain specific fields of discourse and particular forms of knowledge and power is appropriate to the archaeological study of the organisational and institutional aspects of the factory system. Gidden's theory of Structuration offers a means of establishing the material context of those fields of discourse, establishing the factory as a *locale* in which new labour and social relations and class ideologies were worked out during a period of social redefinition and upheaval. The factory is therefore one *locale* within which the *habitus* of different social groups was generated, altered and maintained. In particular, it was a locale within which the capitalist classes expressed their authority over the working classes. The advent of factory-based production also had major implications for the welfare and lifestyles of workers. Their understanding of how to go on in life was epitomised by the spatial changes brought about by the factory, just as a sense of individual and class identity was embedded in the factory as a physical structure and architectural statement.

Furthermore, and because this thesis seeks to approach the organisational and institutional aspects of the factory, the factory is viewed as a *locale* for control. In other words, and according to an organisational interpretation of the factory, the physical structure of the factory will be expected to enable the control of the workforce and supervision of work leading to higher efficiency in terms of output and learning. This favours a 'top-down' approach to the factory but this is relevant within the model proposed above. As the factory was usually the product of the capitalist classes, with the exception of co-operative foundations, it may be expected to have played a role in asserting the dominance of that social group over the workforce. This would be an example of organic solidarity. This has clear parallels with the idea of Closure theory and with the idea of the importance of access to cultural resources and its implications for group identity, social relations and wider social practice.

This in turn advocates a consideration of the spatial form of the factory and its overall architectural style. The formal spatial analysis allows the investigation of the factory and its role in negotiating social relations, suggesting exclusion and subversion on the part of the buildings owner or principal users. In the context of the factory, it is expected that the dominant group is represented by the entrepreneurs or mill owners - the capitalists. Through the formal analysis of space in the factory it may therefore be expected to be able to identify zones and spaces within the mill with a specific social function or meaning, relating to notions of accessibility and access to resources. Such zoning has explicit parallels with Gidden's idea of zoning with the locale, with front and back areas of the social stage. The idea of the factory as a *locale* also enforces the idea of the factory as a *locale* for social identity – both a reflection of the capitalist spirit and entrepreneurial ideologies as well as an arena for the coming together of workers in an environment that defined their social status. As a consequence, the factory may be expected to reflect mechanical solidarity, relating to social and group ideologies.

In this way, the factory as a *locale*, studied through the formal analysis of space and a more qualitative approach to the architectural treatment of the factory has the potential to inform us about a number of different 'fields of discourse' and contribute to a broader, archaeological understanding of the social dimensions of production in the context of the factory system during the industrial revolution, such as those issues previously addressed only by historians. This agenda is therefore framed and engages both with archaeological theory and historical debate. This answers Johnson's (1996, 210-11) plea for historical archaeologists to face the challenge of addressing contemporary and pressing historical debate and wider issues of theory in order to further the intellectual development of their discipline. On the basis of the broadly contextual approach outline above, and by setting it in the context of a more orthodox corpus of literature concerning technology and economics, we may move towards a more holistic archaeological research agenda suited to the study of the social parameters and organisational and institutional elements of the industrial revolution factory.

CHAPTER FOUR
THE YORKSHIRE TEXTILE INDUSTRY - AN OVERVIEW AND METHODOLOGY

'*West Yorkshire has a remarkably rich heritage of historic buildings, a heritage which reflects the county's prosperity - much of it textile based - from the later Middle Ages down to the present century. Textile mills themselves form the most prominent element of this heritage*' (Rhodes 1992, *viii*)

'*The archaeological recording of buildings rests in an analytical, research dimension, which derives from and contributes to questions about that building and wider issues*' (Morris 1994, 18)

4.1 THE BRITISH TEXTILE INDUSTRIES

It has long been recognised that the textile industry was in the vanguard of the industrial revolution (Falconer 1993a, 5) and the significance of textiles to the British industrial experience is beyond doubt, both as a contributor to the British economy and as an employer (Langton 1986, 106). Accordingly, the British textile industry has commanded an important position in industrial revolution history and has frequently been considered the epitome of the transition from pre-industrial structures, through proto-industrial forms and then to industrialisation proper based upon large-scale, centralised production (*cf.* Berg 1994a; 1994b; Markus 1993; Trinder 1992; Tann 1970). Of course, during the industrial revolution, this view represents something of an over-simplification: in reality the textile industry experienced growth and decline and witnessed production on both a small and a large scale in both domestic and factory contexts using manual labour and powered machinery (Berg 1994a, 208). Nonetheless, the gradual concentration of the means of production, from the late eighteenth century, at the factory site makes the textile industries an informative case study of the development of the factory system of production. Moreover, that development and industrial change is fully reflected in the buildings of the industry (Giles and Goodall

1992, 3; Trinder 1992; 189) making them particularly susceptible to archaeological study.

Prior to the industrial revolution the manufacture of textiles was widely dispersed across Britain, but inherent was a degree of regional specialisation. This was the pattern observed by Defoe on a journey across the country in 1726, during which he recorded the manufacture of cloth and druggets in Wiltshire, Gloucestershire and Worcestershire, serges in Devon and Somerset, narrow cloth in Yorkshire and Staffordshire, and half-thicks, kerseys and other coarse stuffs in Lancashire and Westmorland (Defoe 1991). At this time, the textile industry was a common secondary employment, increasingly supplementing the income of a predominantly agrarian society.

From the late eighteenth century the textile sector experienced substantial and impressive growth (Berg 1994a, 208). A key feature of that growth, and symptomatic of the national experience of the industrial revolution, was the marked dynamism of certain industrialising regions and the relative stagnation of others (Berg and Hudson 1992; Hudson 1992, 101). Berg (1994a, 27) has, like Hudson (1989; 1992), drawn attention to the importance of such regionalisation to our understanding of the industrial revolution and has argued that it became a part of the discontinuity and the transformation of the industrial revolution that has hitherto largely been concealed by aggregate analysis. Thus, despite the unifying effect of national infrastructures such as roads, waterways and the railways, regions retained their individual industrial character. That regional character was often dictated by local topography and geology, which established the base of business enterprise, capital, and labour forces (von Tunzelmann 1986, 62-70). The industrial revolution, therefore, resulted in regions whose character was different to those existing now and also to those which had existed prior to industrialisation, and this has led to repeated calls for the adoption of a regional perspective to the study of the industrial revolution. However, Berg (1994, 27) has cautioned that whilst a regional approach must always be present in any analysis of industrial change, it is not a substitute for the study of industries within a national and international context. Consequently, it is appropriate for any detailed study at a regional level to be placed in the context of those national aspects of economic and social development during the period.

The issue of a regional approach to the study of the industrial revolution is particularly germane to this thesis, not least in the interests of manageability since the architectural evidence for the factory system and the textile industries is immense. It is therefore appropriate that a specific region, within which the development of the textile industries and the factory system was particularly marked, should be selected for detailed study. Analysis at a regional level allows industries, sites and buildings from within largely the same geographical, economic and social context to be compared and contrasted.

The Yorkshire textile industry is particularly suited to a regional approach, especially from an archaeological perspective for such a high percentage of its buildings have survived. During the industrial revolution, Yorkshire emerged as a major producer of textiles, with a marked emphasis upon the West Riding (Hudson 1992, 115-6). The industry had a varied character based on five major branches with a broad geographical distribution. This provides an opportunity to study industrial change within a set temporal and spatial context but between and within related industrial sectors. The Yorkshire textile industry has also been the subject of thematic archaeological study and the former RCHME undertook a seminal survey of the buildings of the Yorkshire textile industry in the late 1980s (Giles and Goodall 1992) as part of a trilogy of regional surveys of textile mills in the north of England (see Williams and Farnie 1992; Calladine and Fricker 1993). The results of those thematic surveys complement other specific and intensive RCHME and independent surveys of groups of mills or individual sites elsewhere in the country (see, for instance, Holden 1998; Calladine 1993; Falconer 1993b; Menuge 1993; Watson 1988; 1990; Trinder 1989; Stratton and Trinder 1988) and therefore allow comparison to be made between regions and sectors of the textile industries at a national level.

The first part of this chapter is dedicated to a discussion of the Yorkshire textile industry, aiming to provide a broad overview of its history with a specific focus on its development; it also seeks to establish the broad historical context of the buildings of the Yorkshire textile industry. On the basis of that discussion, and drawing upon the historical arguments concerning the factory system and concepts of social space discussed in Chapter Two, the second part of this chapter will move on to propose an informed methodology, designed specifically to approach the archaeological evidence for organisational change and the social dimensions of production in the textile mill.

4.2 THE YORKSHIRE TEXTILE INDUSTRY: THE ROAD TO INDUSTRIALISATION

Prior to the industrial revolution, the production of textiles was widespread across England. However, few areas rivalled the diversity and scale of the Yorkshire textile industry, which, before 1780, was based on a number of deeply entrenched branches (Plate 6). Of these, the woollen branch was the oldest established and spread over the widest area: from Saddleworth in the far west, through the Colne, Holme, Dearne and Upper Don valleys, in the mid Calder valley from Sowerby Bridge to Wakefield, in most of the area between the Aire and Calder east of Bradford and west of Leeds, and in the mid Aire valley in the Yeadon and Guisely areas (Giles and Goodall 1992, 3-5). Second in rank was the worsted branch. The manufacture of worsted had spread following the introduction of the new draperies in Norfolk in the sixteenth century and spread rapidly within the West Riding during the eighteenth century (Berg

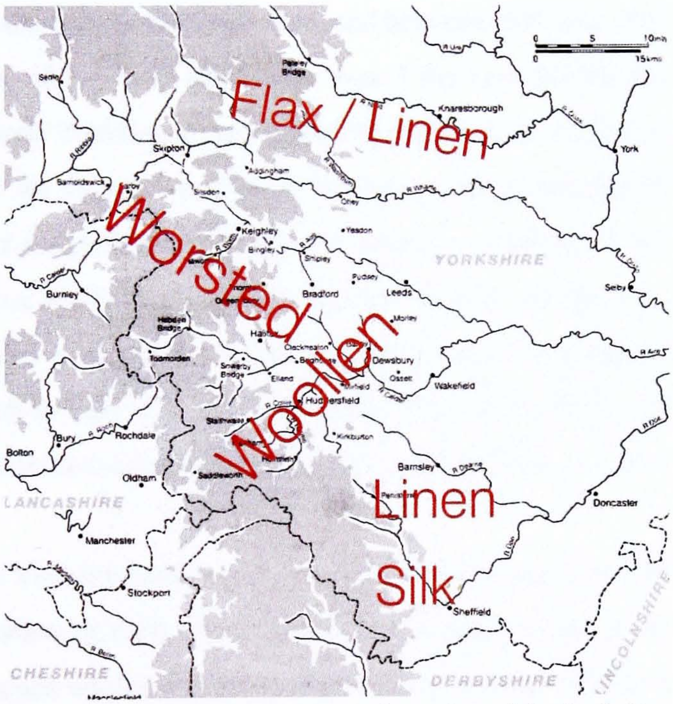

Plate 6 *Distribution of the main branches of the Yorkshire textile industry prior to the industrial revolution (after Giles and Goodall 1992 xii)*

1994a, 209). Within Yorkshire, the worsted industry had a particular distribution in the hinterland of Bradford, in the Worth and upper Aire valleys around Keighley, and in the upper Calder valley where Halifax was the principal marketing centre.

Third in rank was flax and linen. Regionally significant, especially in parts of Scotland (see, for instance, Watson 1988; 1990; Bremner 1969), the flax and linen branch experienced substantial growth in Yorkshire before 1850 but only within specific areas and Leeds and Barnsley emerged as major centres of production. By the 1830s, it had been supplanted by the cotton industry but although it remained a staple product in some areas of the county, numerically the branch remained small and between 1835 and 1893 the highest recorded percentage of flax and linen mills was 5 per cent (Giles and Goodall 1992, 3). To these three 'traditional' pre-industrial branches in Yorkshire should be added silk. Despite an attempt in 1760 to introduce silk production to Sheffield, the industry remained insignificant in Yorkshire, largely reflecting the fact that the silk industry in Britain as a whole faced fierce foreign competition and bore the handicap of an expensive, luxury commodity. As an industry it only flourished in isolated pockets of industry such as East Cheshire (Calladine and Fricker 1993), the Spitalfield weavers in London, and the Coventry ribbon industry (Berg 1994a, 219-20).

The sectoral divisions within the Yorkshire textile industries particularly emphasise the varied character of the organisation of each of the branches, the pre-existing social structure upon which that production was based, and the influence of that pre-industrial social organisation on the route taken by each branch during the industrial revolution and rise of the factory system of production.

In the eighteenth century, woollen and worsted manufacture in Yorkshire was distinguished by two different forms of industrial organisation and division of labour within and between households (Kussmaul 1994). The woollen industry was structured around the independent artisan manufacturer who employed their own family and a small number of journeymen (Plate 7). In contrast, the worsted industry in the West

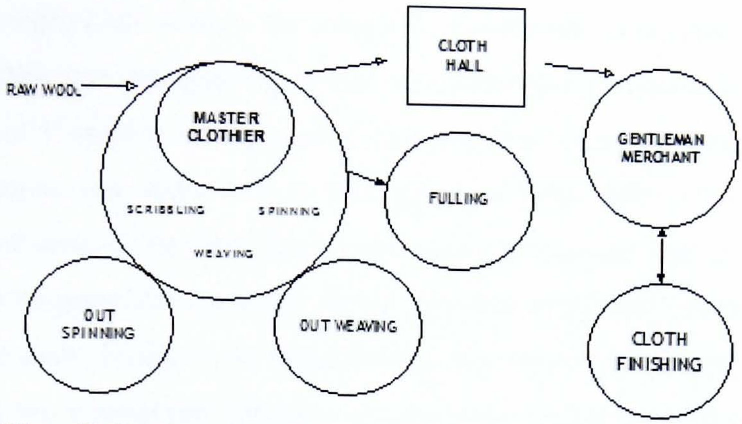

Plate 7 *Organisation of the pre-industrial Yorkshire woollen industry (after Randall 1989, 180-1)*

Riding was dominated by the putting-out system. Here, in areas of more marginal agricultural potential, yeomen emerged as putting-out merchants, and there emerged a strong capitalistic basis to the industry. These yeomen had sizeable farms which they used to raise capital and credit, they let cottages and plots to their employees, and distributed raw materials to large numbers of spinners and weavers who worked for piece rates in their own homes (Hudson 1992, 116) (Plate 8). Although domestic based spinning rarely led to specialised buildings separate from the home, a characteristic of weaving under the putting-out system was the emergence of distinctive top-floor weaving shops, lit by long rows of mullioned windows (Palmer and Neaverson 1994, 96; Giles and Goodall 1992, 19). Finished goods were collected by the clothier or his middlemen and taken to local market centres, such as Leeds, Halifax and Wakefield, or were bought by larger clothiers who sold goods to merchants from London and Yorkshire (Berg 1994a, 215-6). Heaton (1920, 297) eloquently summarized the differences between the Yorkshire woollen and worsted industries, noting that the former was dominated by 'a large number of small men', whilst the latter was dominated by 'a small number of large men'.

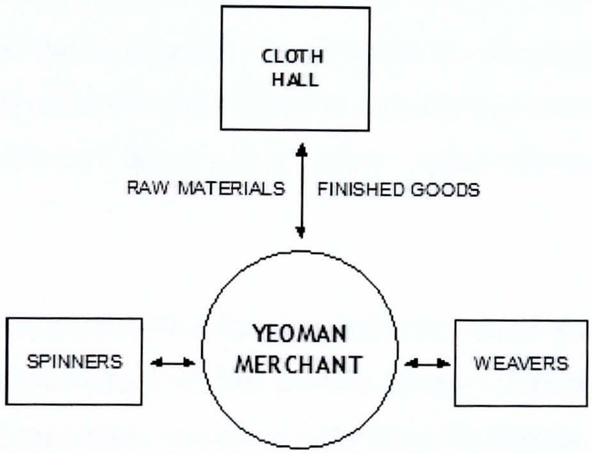

Plate 8 *Organisation of the pre-industrial worsted industry*

During the course of the eighteenth century, the output of the British wool sector increased by 150%, but within that aggregate figure there was a dramatic relocation in favour of the West Riding of Yorkshire, whose share of the national product, including wool and worsted production, rose from 20% to 60% (Hudson 1986; 1992, 116). Thornes (1981, 7) explored some of the main factors that might have caused this re-location of the industry with particular emphasis on the presence of plentiful local supplies of water, coal and wool. However, he found that fast flowing water was only a crucial factor following the widespread adoption of machinery which required a powerful source of motive power and, anyway, much of the eighteenth century development of the textile industry took place when hand powered machinery was dominant. Furthermore, he suggested that coal cannot be considered an influential factor until the advent of steam-powered mills in the late eighteenth and early nineteenth centuries, nor could supplies of the local wool, which was of a coarse variety and was never used in an significant quantity.

Historians have sought alternative explanations in an attempt to explain the social and economic conditions favourable to the rise of the Yorkshire woollen industry. A great deal of emphasis has been placed on the importance of tenurial factors (see, for instance, Ellis 1962). Much of the industry was located on crown lands in the manor of Wakefield and within the Honour of Pontefract. Manorial control over lands under the jurisdiction of the former, which included the remote and agriculturally unproductive Calder Valley, appears to have been particularly loose. This left the inhabitants free to buy and dispose of land with relative ease, encouraging the adoption of a system of portible inheritance through which land was divided between some or all children, rather than through a system based upon the principle of primogeniture (Thornes 1981, 7). Consequently, land was continually sub-divided amongst a growing population until individual holdings became too small to support their occupants by agriculture alone. A supplementary or alternative source of income became necessary to support an increasingly large and densely settled rural population, and such an alternative was provided by a domestic-based woollen industry and was reflected in the provision of purpose built 'workshops' for the production of woollen products in a domestic setting.

The development of the woollen industry in the West Riding was further stimulated by the way that it was organised. Unlike the guild-dominated textile industries of the declining urban centres, which regulated the number of practitioners of the craft by strict control of access to it, entry into the woollen industry in the West Riding was relatively easy (Thornes 1981, 7). The major hurdle of setting up as a clothier was the initial cost, but in comparison with other regions like East Anglia and the West Country, this impediment was negligible in Yorkshire.

Within the woollen industry, contrasts between the organisation of the pre-industrial woollen and worsted industries became intensified as the process of industrialisation advanced during the late eighteenth century. The putting-out system, which characterised the Yorkshire worsted industry, readily developed into the factory system for its small capitalist basis easily translated into a system of large mill owners and labourers, even despite initial opposition to factory-based production from within the industry (Berg 1994a, 225). In contrast, the woollen clothier survived well into the nineteenth century, but the earlier system adapted to needs for additional space and power by introducing co-operative mills for the use of small clothiers, as well as examples of individually owned sites (Giles and Goodall 1992). However, it was in the worsted industry that the factory system tended towards a greater concentration of production and on a larger-scale. Whilst early woollen mills were very much a part of the traditional artisan structure, worsted mills were the manifestation of the development of the putting-out system into full-blown capitalistic structures. Thus, whilst both sectors took advantage of the factory system and the advantages of centralised production, they differed greatly in their social relations of production (Berg 1994a; 1994b).

The putting-out system likewise prevailed in the linen industry for much of the eighteenth century and even when other branches had largely adopted the factory system of production there was a tendency for this branch to remain comparatively small-scale, non-commercial and based in a domestic setting. Nonetheless, the flax and linen industry thrived in the Nidderdale and its tributary valleys and Leeds emerged as a centre of flax-spinning and Barnsley as a linen weaving centre and some spinning and weaving factories were built in these areas (Giles and Goodall 1992, 5). However, despite something of a boom during the late eighteenth and early nineteenth centuries, the Yorkshire flax and linen industry experienced decline and thereafter many flax mills in Yorkshire reverted to rope making.

The production of cotton in the pre-industrial period was largely based on the co-existence of agriculture activities and the manufacture of textiles. The organisation of the cotton industry was in part a product of the fustian industry, a mixed cotton and linen cloth, and which had been based on the putting-out system. However, the putting-out system that underpinned the cotton and fustian industries differed to that of the Yorkshire worsted industry for by the middle of the eighteenth century market prices and the price of yarn within the industry were not controlled by larger merchants, and the industry was based solely on the systematic intervention of small middlemen. It was the importance of the small yeoman capitalist, which led to the successful growth of the cotton trade in Lancashire and Derbyshire, but in other areas the presence of a large number of middlemen generally hindered the development of the industry.

However, where the cotton industry flourished there is a close relationship between the development of the cotton sector and the rise of the textile factory. The first cotton mill was built in Yorkshire in 1770 and within the next thirty years over 200 new cotton mills had been built in the upper Calder Valley, the northern Dales and the Keighley and Bradford areas (Giles and Goodall 1992, 5). Furthermore, many of these early mills were built on the basis on the Arkwright-type mill, a form of factory designed to house the new machinery patented and sold under licence by Richard Arkwright and developed at his cotton producing sites in the Derwent Valley, Derbyshire. The Arkwright-type mill may be seen to have established something of pattern for mill building in the late eighteenth century and its spread was apparently coeval with the licences for Arkwright-type machinery (Chapman 1981-2).

Broadly speaking, industrialisation of the cotton industry brought about the intensification of existing forms of work (Berg 1994a, 229). The cotton industry had the advantage of using a fibre which readily lent itself to mechanisation and which tended to use smaller amounts of raw material per unit produced (Timmins 1996, 16). Assisted by rapid technological development, the development of proto-factories within the cotton industry was perhaps inevitable, but it was also the product of key business decisions and much of the success of the cotton industry reflects a classic case of capitalist concentration. The cotton trade also rose on the crest of a growing wave of popularity for cotton goods, which ultimately brought about the demise of the flax industry by supplanting linen as a fashionable cloth (Thornes 1981, 26; Ingle 1997). As an industry, some have suggested that cotton played a pivotal role in the national economy, and Rostow (1960; 1995) saw it as one of *the* industries responsible for the nation's 'take-off' into sustained economic growth. However, more recent assessments have suggested that the impact of cotton on the national economy was less substantial (see, for instance, Deane and Habakuk 1992), but such aggregate analysis conceals the important regional contribution of the industry, particularly in Lancashire and parts of Yorkshire (Timmins 1996, 18).

Although the classic view of the cotton industry is one of sudden boom and large-scale success, the majority of early cotton mills were small-scale (Berg 1994a, 232). Furthermore, it was not uncommon for even large, wealthy cotton manufacturers to invest in several smaller factories rather than one, large-scale site, thus avoiding the risk of losing everything should the industry fail. Thus, despite the influence of the Arkwright-type mill within the industry, early mills within the cotton industry adopted a number of different forms, and the renting out of space within cotton mills, as with woollen mills, was not uncommon. Within Yorkshire, the cotton boom ended in the early nineteenth century and many businesses in the Bradford and Keighley areas converted to worsted production (Ingle 1997). However, after 1850, cotton remained dominant in the upper Calder valley, in Craven and in the Northern Dales. Towards the end of the nineteenth century, cotton also flourished in the heartland of the traditional woollen and worsted zones, such as Brighouse and the Colne Valley, being well placed to supply warps to mixed-cloth manufacturers.

4.3 THE YORKSHIRE TEXTILE INDUSTRY: THE AGE OF MILL BUILDING, *c.*1780-1930

It has been argued that the textile mill defines the architecture of Yorkshire (Hatcher 1985; Thompson 1989) and the principal focus of this thesis is that period between the late eighteenth and early twentieth centuries during which time developments within the textile industries led to a distinctive age of mill building in Yorkshire. On the basis of factory returns, cartographic sources and surviving archaeological evidence the numbers and distribution of mills in Yorkshire can be assessed (Giles and Goodall 1986; 1992).

The development of the Yorkshire textile industry from the late eighteenth century led to an increasingly diverse number of branches whose growth was often important in the emergence of the rural and urban environment, which survives to this day. Between *c.*1780 and 1829, just fewer than 270 textile mills, in the sense of a centralised factory, are known from within Yorkshire (Plate 9). The greatest proportion of these were woollen mills reflecting a long history of wool production in the county whilst the numbers of early cotton and worsted mills in the county are remarkable similar (38 and 34 respectively) reflecting a cotton 'boom' in the upper Calder Valley and the Keighley and Bradford areas balancing out the established worsted branch. Less well represented

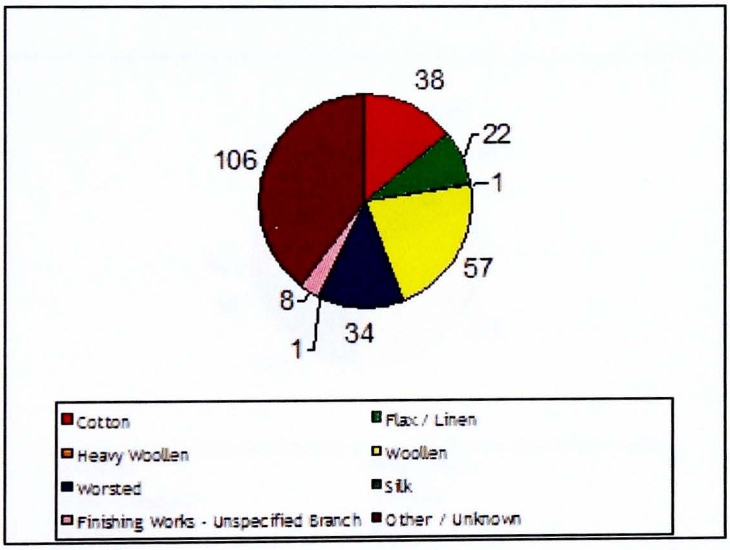

Plate 9 *Numbers of known Yorkshire textile mills operating c. 1780-1829*

were the flax, linen, silk and heavy woollen industries, the latter not really experiencing significant growth until the mid-nineteenth century. The geographical distribution of the early Yorkshire textile industry (Plate 10; p87) shows a marked concentration of sites on river sites, reflecting the dependence of the industry at that time on waterpower. The woollen branch occupied a broad area in the Colne, Holme, Dearne and Upper Don valleys whilst worsted production was concentrated in the hinterland of Bradford and in the Worth and Aire valleys around Keighley and in the upper Calder valley where Halifax was a major marketing centre (Giles and Goodall 1992, 5). Early cotton production was focussed in the Keighley area but had a stronger presence in the Colne valley and the upper Calder valley in the Todmorden area. Flax and linen were concentrated initially in Nidderdale and a lone flax mill was built in York shortly before 1816.

Between *c.*1830 and 1879, the Yorkshire textile industry experienced substantial growth and some relocation occurred within its branches (Plate 11). By this time the proportion of cotton mills operating in the Yorkshire textile industry as a whole had not significantly increased from the period *c.*1780-1829 and this reflects the growth of the other branches as well as the end of the cotton boom in the Keighley area and Bradford hinterland following which many newly built cotton mills were converted for worsted production. The woollen industry experienced moderate growth as did the worsted industry. In contrast, the flax and linen industry as well as silk production had only experienced minimal growth and contraction of these branches was well under-way

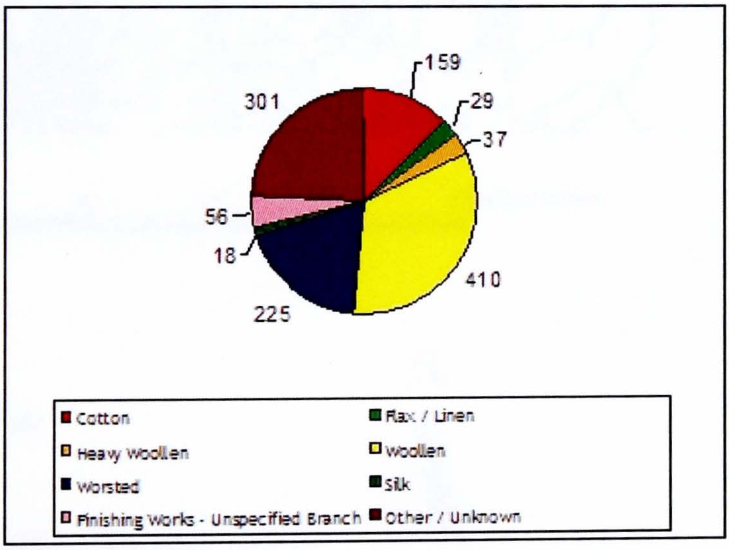

Plate 11 *Numbers of known Yorkshire textile mills operating c.1830-1879*

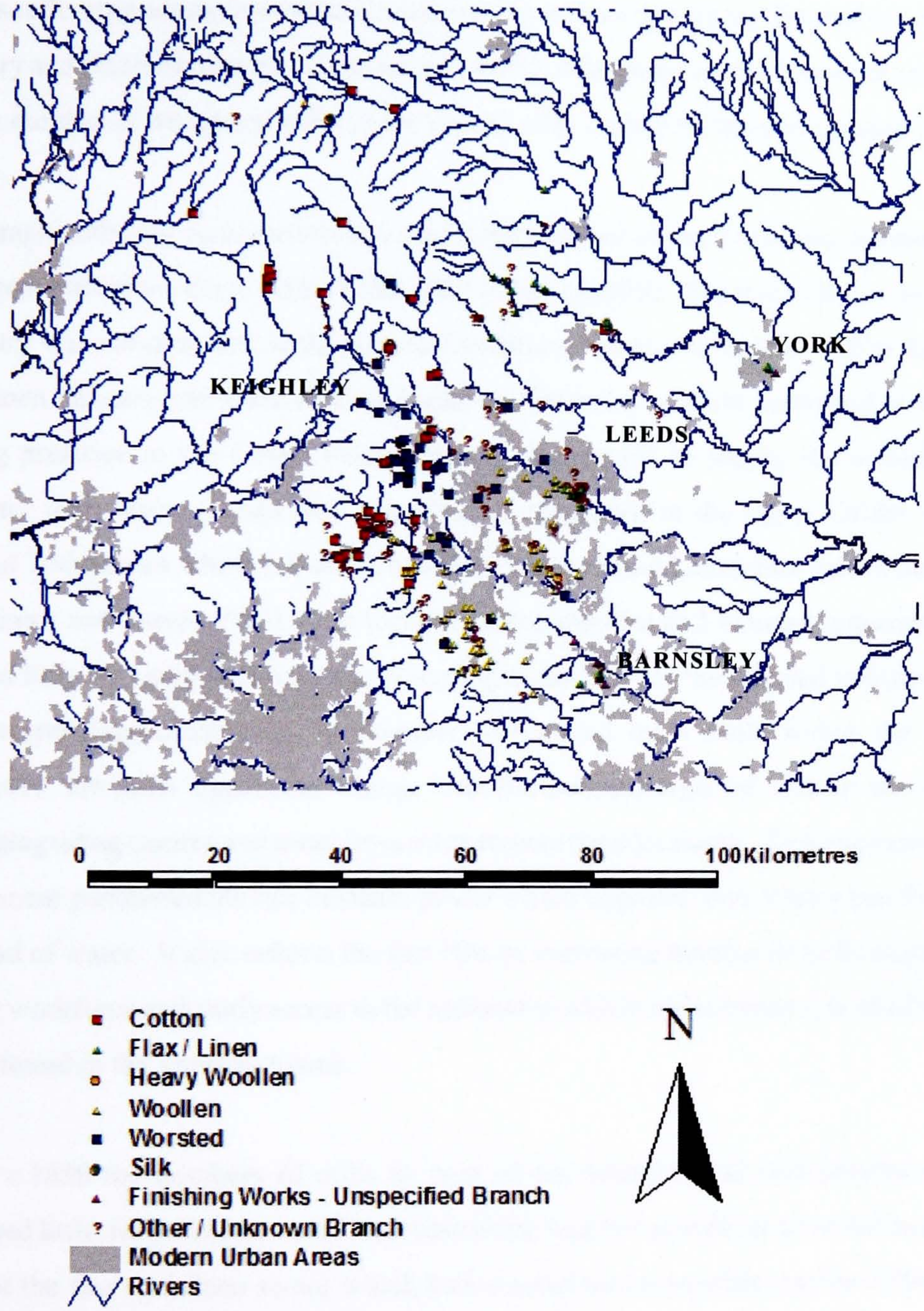

Plate 10 *Distribution of known Yorkshire textile mills operating c.1780-1829*

by *c.*1850. Increasingly represented was the heavy woollen industry as were finishing works reflecting advances in dyeing and printing technology during the mid nineteenth century and also reflecting the existence of specialist finishing works despite an increase in the number of integrated mills in the county after *c.*1825 (Giles and Goodall 1992).

Geographically, the mid nineteenth century distribution of the Yorkshire industry had changed little since the period *c.*1780-1829 (Plate 12, p89). The rise of heavy woollen industry was concentrated in the area of Dewsbury, Ossett and Morley whilst the flax and linen industry had taken hold in Leeds and Barnsley. Cotton continued to have a strong presence in the Colne Valley where it had begun to supply the mixed fibre industry with warps; it had also experienced expansion in the upper Calder valley around Todmorden where it literally bordered the booming Lancashire cotton industry (Williams and Farnie 1992). The location of the woollen and worsted industries had shifted little although Bradford was emerging at the heart of the worsted industry with a corresponding increase in the number of worsted mills built within the town. However, the most significant change was the concentration of sites in the newly emerging urban centres and away from more remote rural locations. To some extent this movement parallelled the rise of steam power which liberated sites from a fast flowing or head of water. It also reflects the fact that an increasing number of mills required a larger workforce and ready access to the national transport infrastructure, both of which were found in the growing towns.

After *c.*1880 the numbers of mills in each of the branches had still proportionally changed little, reflecting an overall increase in the number of mills in all of the branches except the flax and linen sector which had entered an irreversible decline (Plate 13, p90). Geographically (Plate 14, p91) the flax and linen industry had largely retracted to Nidderdale and many of its mills converted to rope making. In contrast the worsted and woollen industries continued to thrive though there was a gradual blurring of the demarcation between their zones and areas traditionally noted for woollen production, such as Leeds and Huddersfield became involved in the manufacture of worsted products. Furthermore, many of the worsted mills in Bradford and Keighley areas

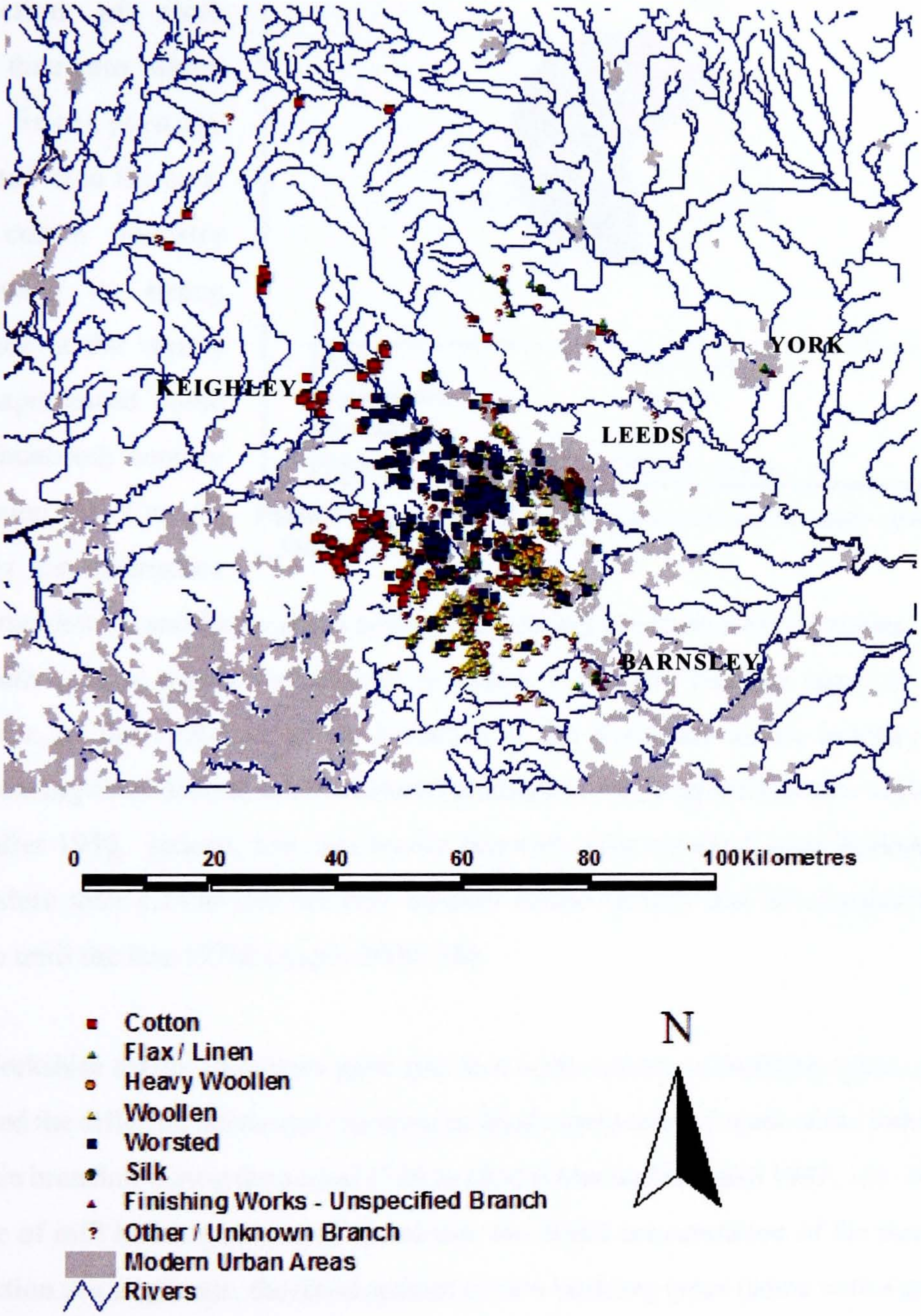

Plate 12 *Distribution of known Yorkshire textile mills operating c.1830-1879*

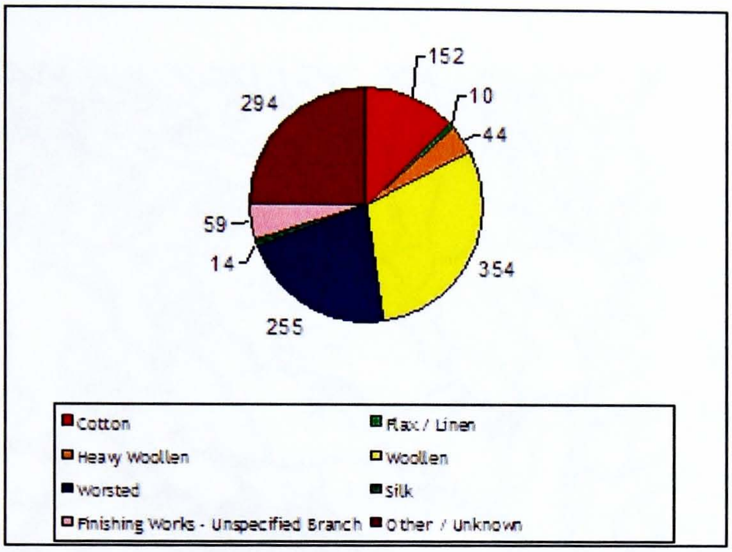

Plate 13 *Numbers of known Yorkshire textile mills operating c.1880-1930*

converted to the production of cloth rather than yarn, which was increasingly imported in to the area. The cotton industry maintained its strong presence in the county and experienced some late nineteenth century expansion in to Craven, notably the emergence of Barnoldswick and Earby (both now in Lancashire) as cotton weaving towns. Early twentieth century trends are difficult to assess as Factory Returns cease in 1905. However, by the 1920s all of the branches of the Yorkshire textile industry were experiencing some decline and the industry gradually contracted and few new mills were built after 1930. Indeed, few new textile factories were constructed in Yorkshire or Lancashire after *c.*1930 and the first modern textile factory was not constructed in Britain until the late 1970s (Aspin 2000, 18).

The Yorkshire textile industries gave rise to a wide variety of building types, which reflected the differing needs and changing methods and scales of work of the industry's six main branches during the period 1780 to 1930 (Giles and Goodall 1992, 16). Within the age of mill building, a general trend saw the initial concentration of the means of production at a single site, the development of new building types (some with a general use and others with a specific use), and the gradual development of many sites into fully integrated productive units.

Something of the varied character of the buildings of the Yorkshire textile industries is apparent from even a brief overview. Often, new building types in the industry adopted the names of the principal processes that they contained. Thus, emerged hackling and

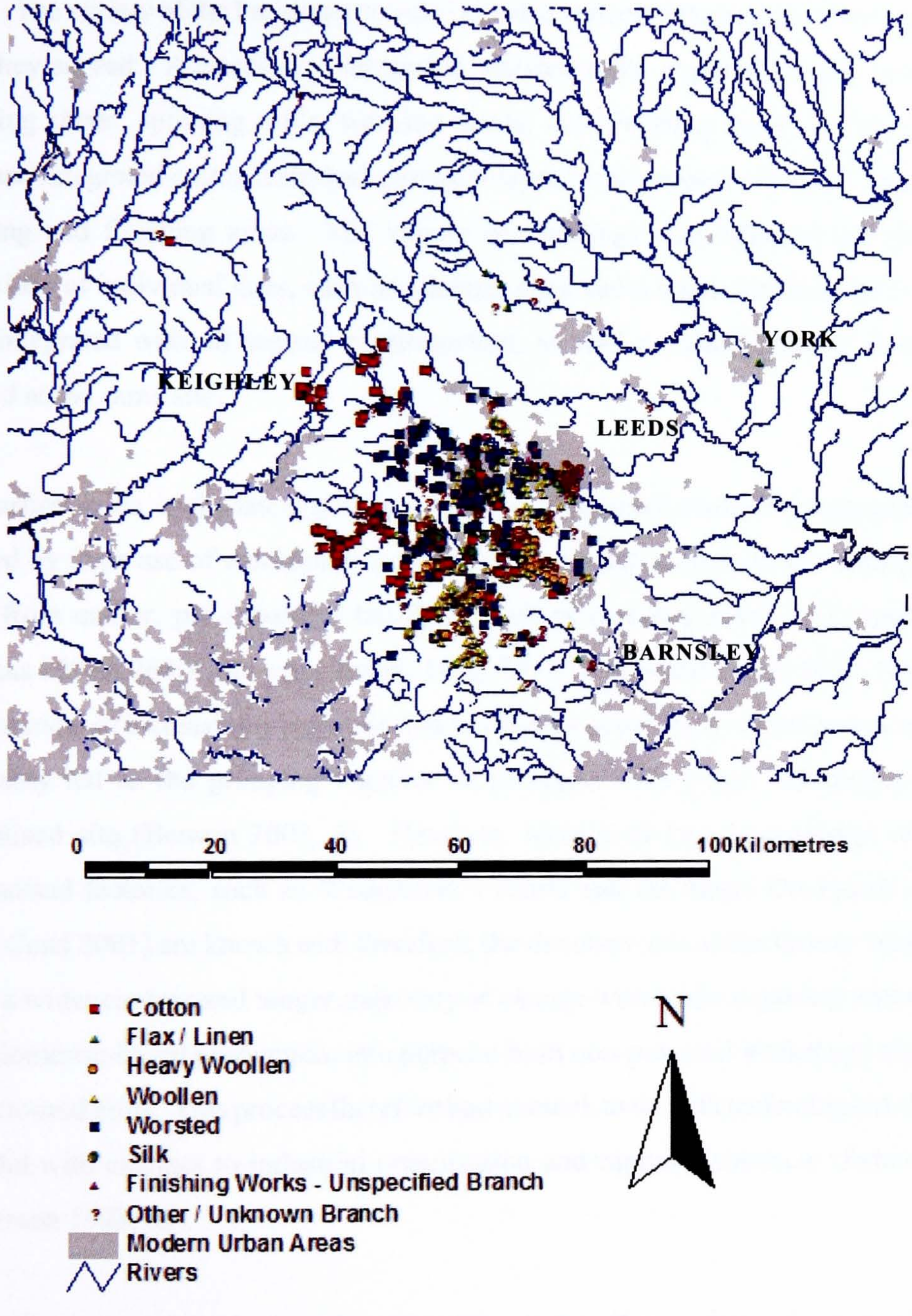

Plate 14 *Distribution of known Yorkshire textile mills operating c.1880-1930*

combing shops and sheds, loomshops, multi-storeyed spinning mills, weaving sheds and so on. The variety of the buildings constructed also reflected the branch of the industry that they served. Accordingly, integrated worsted mills required sorting facilities, combing sheds, spinning mills, weaving sheds, and finishing areas, whilst, and in contrast, integrated cotton mills had a simpler layout with preparatory sheds, spinning, weaving and finishing areas. The variety of buildings also reflected the scale of operations at individual sites, such as whether sites had a specialist function or were fully integrated with all aspects of production, as well as administrative functions, located at the same site.

The earliest mills, in the late eighteenth and early nineteenth centuries, were generally defined by their use of mechanical power from a central power source, setting them apart from earlier, pre-industrial buildings such as combing sheds and loomshops (Markus 1993a, 264; Giles and Goodall 1992, 78; Williams and Farnie 1992, 11). The development of increasingly sophisticated machinery, requiring a central power source, inevitably led to the grouping together of processes in a single building or at a centralised site (Benson 2002, 9). However, some well known examples of non-mechanised factories, such as Wedgwood's Eturia and the Royal Dockyards (Tann 1970; Coad 2001) are known and, therefore, the development of the factory should be set in a wider context and longer trajectory of change which saw a gradual movement from domestic-based production, into purpose-built non-powered workshops and then into powered mills. This process therefore had as much to do with technological change as it did with changes to industrial organisation and capital investment (Palmer and Neaverson 1998, 63).

Typically, early mills had a specialised function, that is, they were involved in only one or two stages in the production of finished cloth. Early mills usually provided facilities for the proprietor, tenant, partnership or company (Giles and Goodall 1992, 79). At some sites, existing buildings, such as corn mills, were adapted, taking advantage of the existence of a large-structure and, usually, an existing source of power. However, most mills after 1780 were purpose-built on new sites. Early mill sites tended to be located near to a source of waterpower, typically comprising a principal building, such as spinning-mill around which there might be various ancillary buildings. The scale of sites could range from individual buildings to relatively large complexes.

However, a major characteristic of early mills was the persistence of off-site working, reflecting the fact that the transition to the factory did not necessarily mean the replacement of earlier forms of industrial organisation (Palmer and Neaverson 1998, 63). Of course, much of this was dictated by the progress of mechanisation within and between industries. By the early nineteenth century the mechanisation of the preparatory process in the cotton and woollen branches had put an end to outworking in the preparatory stages of production, but flax heckling and worsted combing remained hand-powered for some time, often undertaken in separate premises away from the mill site. Furthermore, weaving continued to be undertaken in loomshops during the early nineteenth century until the development of a successful power loom in the 1820s, whilst specialist trades such as dyeing, bleaching and printing, also remained outside the mills (Giles and Goodall 1992, 84).

Therefore, before *c.*1825, the Yorkshire textile industry was largely characterised by organisational and geographical fragmentation. However, there were some early experiments in integrated working, and, paradoxically, many of these took place within the woollen branch, which at that time largely remained made up of by small-scale operations and dominated by the domestic artisan clothier. Early integrated mills usually combined newly mechanised processes with hand-powered stages of production at a single site (Giles and Goodall 1992, 85). This raises an interesting point. There is evidence, even after the initial boom of the industrial revolution, for the centralised factory emerging out of technological and organisational concerns, and early integrated sites indicate the exploitation of both new powered processes and the benefits of a centrally organised workforce. This much is clear from the archaeological evidence from the Yorkshire textile industries, as we shall see later in Chapters Five, Six and Seven (see also, Appendix A).

The period *c*.1825-1930 is generally accepted as the zenith of factory-based production in the Yorkshire textile industries. By *c*.1825, virtually all aspects of the industry had become mechanised and continued technological development had led to the development of mill sites with a hitherto specialist function and the widespread adoption of integrated working. The industry also benefited from the use of new sources of motive power (including steam engines, gas and electricty) as well as new systems of power transmission and developments in structural engineering, including steel and concrete frames. In Yorkshire, the textile sector further diversified during this period with the development of the heavy woollen industry, hybrid cotton and woollen products and other related sectors including carpet manufacture and the clothing trade. However, small-scale production remained significant during the period and many small firms successfully competed with the larger companies. The road to the factory system in the Yorkshire textile industries was neither entirely straightforward nor wholly progressive.

During the period *c*.1825 to 1930, a variety of forms of industrial organisation underlying mill-based production became apparent. The majority of mills were owner-occupied. However, others were built for occupation by two or more tenants, an arrangement leading to 'room and power' mills, and which was particularly common in the cotton industry. The letting of space and power in a mill was especially common in the earliest years of the factory system and appears to have been an opportunistic arrangement (Giles and Goodall 1992, 107-8). For the builder, there was the advantage of a rental income from tenants and the potential to take room themselves, whilst for the tenant the renting of room and power had the advantage of low capital outlay. This allowed men of small means to participate in the booming factory-based industry, and often provided a stepping-stone for later expansion into purpose-built, owner-occupied sites. It was common for many tenants to occupy only a single floor of a mill and therefore it was usual for a number of different processes, normally undertaken in separate buildings, to be housed together (Williams and Farnie 1992, 66).

A further form of industrial organisation within the industry was the ownership of a mill by a co-operative. In this instance, a collective of individuals held shares in the building and, in many cases, operated the mill themselves. Generally speaking this form of mill organisation was strongest in Lancashire, particularly in the Rochdale area, and never had a particularly strong influence in Yorkshire.

From the early twentieth century the story of the textile industry in Yorkshire is largely one of decline in overall output, numbers employed and the number of mills in operation. However, the rate of decline depended on the individual branches, so, for instance, flax and linen was in terminal decline even before 1900 with few new mills being built after *c.*1850, cotton continued to perform well up until the early twentieth century, whilst the woollen sector capitalised on new markets in South America, the Far East and the Empire, particularly during wartime (Giles and Goodall 1992, 119).

Between 1900 and 1930 a relatively small number of mills were built in Yorkshire, whilst many existing sites were partially rebuilt or expanded. Most of the new mills had a specialist function, with a particular focus on spinning, weaving, or shoddy and mungo production. The overall impression is one of simplicity, with a main mill building and smaller ancillary buildings grouped around it. This represents something of a return to the form of the earliest sites. A major factor in the design of early twentieth century mills was the use of gas engines and electricity, the latter in particular changing the classic arrangement of the mill by removing the need for a central power source and physical means of power transmission. However, steam plants continued to be installed at some sites until World War I (1914-18). Integrated sites were also built during the period, but it was common for spinning and weaving to be accommodated in the same building and single-storey sheds became a typical form for textile producing sites. During the 1930s, the textile industry retracted and the age of new building all but came to an end.

4.4 THE YORKSHIRE TEXTILE INDUSTRY - AN ARCHAEOLOGICAL AGENDA

It is clear from a brief overview of the Yorkshire textile industries that the emergence of the factory system within that region, and its application within the different branches of the industry, was dependent on a number of different factors. First, there is a clear relationship between the pre-existing social structure upon which sectors of the industry were based and the route taken to industrialisation, and the differences between industries largely determined the adoption of the centralised factory. Second, it is apparent that a number of functional issues, including the efficiency of production and the need to house increasingly sophisticated powered machinery and a number of different processes, played a role in the choice to pursue factory-based production and, at least partly, the form of the mill. However, it should be recalled that the route to industrialisation based on factory-based production within the textile industries was neither straight-forward or inevitable, for even after the widespread adoption of the factory system traditional methods of production continued to persist in some branches, whilst in others the mill itself underwent considerable development in order to incorporate new machinery, sources of power, and in response to supply and demand. What follows is a specifically archaeological approach to this evidence.

The buildings of the textile industries have the potential to tell us more about the material structuring of labour relations and wider social practice in an emerging system of industrial organisation which played a major role in the movement towards the factory system. Previous attempts to establish the organisation and social context of the textile mill are perhaps few in number but have been central to the development of the thinking and methodology of this project. Of considerable interest is the work of T.A. Markus (1993a) on the factory has already been discussed in Chapter Three. The remainder of this chapter seeks to develop a methodology through which his model of the three structures inherent in the factory – power transmission, spatial and social – can be used within an archaeological framework.

Whilst Markus (1993a) himself does not develop his model within an archaeological context, it has clear archaeological potential. Of particular interest is the emphasis that his model places on the role of a number of different factors, including the technological *and* the social. It is these dialogues, especially the social dimensions of production, and this thesis seeks to develop that model within an distinctly archaeological research framework. A major underlying concept, drawing explicitly on the work of Giddens (1984; 1985), is the idea of the mill as one of a number of different *locales* through which class relations and social practice were constructed during the industrial revolution.

4.4.1 A RECORDING STRATEGY AND ANALYTICAL FRAMEWORK

It is necessary to establish a recording methodology suited to the articulation of the research agenda outlined above in relation to the buildings of the Yorkshire textile industry. A major component of that methodology is the archaeological recording of standing structures. In recent years the nature of recording strategies concerning buildings has been the focus of significant debate (*cf.* Ferris 1989; 1991; Meeson 1989; Smith 1989; Bold 1990; Wrathmell 1990). This thesis upholds the position that 'recording is not an end in itself' (Ferris 1989; 15) and that the end result of a recording project should be 'value rich' and fulfil an interpretative potential (Grenville and Morris 1991, 5; 1992). It accepts that recording is a highly selective act and that the concept of a 'total' record is an archaeological chimera. This draws explicitly on Carver's (1980; 1990, 77-82) insistence that all archaeological recording should be underpinned by a sound research agenda and that recording strategies should be concerned to identify levels of archaeological recovery appropriate to that agenda. These principles are formally expressed in the English Heritage document *Management of Archaeological Projects* ('MAP2': English Heritage 1991), and have been established in a number of specifications specifically related to the archaeological recording and survey of standing structures (see, for instance, English Heritage 1991; 1998; n.d; Molyneux 1991; National Trust 1991; RCHME 1996; Dallas 2003).

The archaeological recording of buildings therefore 'comes down to a matter of choice on the part of the recorder' (Grenville and Morris 1991, 2). The individual researcher must reserve the right to select a recording strategy that fulfils an essential intellectual role, reflecting the aims of the research agenda pursued (Morris 2000, 120), but which is also framed by a number of practical considerations such as time, resources, and access to individual sites. In so much as individual projects may share standard approaches to the recording of standing structures they will inevitably, on the basis of different research questions and practical considerations, be unique (Baker and Meeson 1996, 19). The recording strategy and analytical framework outlined below acknowledges this position and are specifically concerned with establishing a means of understanding more about the social dimensions of production in the textile mill and demonstrating the potential of material culture studies to contribute to our understanding of the industrial revolution.

A major factor determining the methodology pursued by this thesis is the existence of existing records and surveys of Yorkshire textile mills. The survival of a high percentage of textile-producing sites and buildings in Yorkshire makes this region particularly susceptible to archaeological study, but the sheer scale of the surviving evidence presents a problem in terms of data collection and analysis. During the 1980s the former Royal Commission on the Historic Monuments in England (RCHME) undertook a thematic study of the textile mills in Yorkshire, one of the major objectives being to produce a gazetteer of all known textile-producing sites in the county (Giles and Goodall 1986 71-2; 1992). The survey concentrated on textile producing sites between the late eighteenth century, when new developments in machines and power generation led to expansion of production and an era of mass production, and the second quarter of the twentieth century when the industry contracted and the age of new mill building formally ceased (Giles and Goodall 1992, 1). Upon completion, the gazetteer included around 1,800 individual sites covering a time period between 1770 and 1930 and for each site an 'initial survey form', comprising basic information about the surviving buildings at each site, completed. Although nominally a study of textile mills in the historical county of Yorkshire, the RCHME survey in fact concentrated almost entirely on the former West Riding – the rest of the county, where the textile industry was of only local importance, was not covered systematically (Giles and Goodall 1992, 1). For practical reasons, principally available time and resources, this thesis will use the RCHME gazetteer as a basis for further research; it therefore respects the same geographical and chronological limits as the RCHME survey. Therefore, and because the work of the RCHME Yorkshire textile mills gazetteer is fundamentally important to this research, it is necessary to consider that survey in greater detail.

4.4.2 RCHME YORKSHIRE MILLS SURVEY

The compilation of the RCHME Yorkshire mills gazetteer had three well defined stages: identification, initial site visits, and basic analysis of the resulting gazetteer. The identification of mills for inclusion in the survey was based initially on the examination of cartographic evidence. Textile mills dating from the industrial period are relatively easily identified through the use of maps of different dates, allowing the RCHME to make broad observations about the geographical and chronological distribution of textile-producing sites in the county and, critically, allowed the number of industrial revolution mills at any one time to be broadly quantified.

The principal source for identification was the OS County Series 25" maps of the period *c.*1920 to 1935. This series has the virtues of a consistent coverage of a wide area and the maps named individual mills and sites and, for the most part, showed to which branch of the textile industry that site belonged as well as recording cases of disuse. Revisions of the years 1920 to 1935 were specifically selected because the RCHME felt that these maps would show the largest number of mills. Many early mills would still be in use or extant, most nineteenth century mills would appear as working sites, whilst the latest generation of twentieth century mills would also be included. Furthermore, the large scale of the maps (25" to 1 statute mile) proved large enough to show individual sites in some detail and allowed some comment to be made about their size and complexity (Giles and Goodall 1986).

However, the use of early twentieth century 25" maps as a means of identification does have some deficiencies. For instance, large numbers of small-scale workshops, which constantly came in and out of the trade, were not always shown individually, particularly in urban areas. Consequently, there is a tendency for the 25" series maps to be biassed towards larger establishments and thus characteristic aspects of the industry, such as small-scale units of production and out-working establishments, are likely to be overlooked. In order to counter this problem, and to account for general inconsistencies between maps, the RCHME consulted alternative cartographic sources. These included very large-scale plans (1:1056 and 1:500) and a series of OS first edition maps at a scale of 6 inches to one mile, surveyed and published *c.*1850. In this way, and by checking a variety of cartographic sources against each other, the RCHME confidently identified over 1,800 textile producing sites.

The next stage in the survey involved visits by researchers to each of those 1,800 sites in order to record, very briefly, what had survived into the present day. This process of initial survey was

Royal Commission on the Historical Monuments of England

TEXTILE MILLS: INITIAL SURVEY

Provisional monument number 0/29 Final monument number [illegible]
County WEST YORKSHIRE District K NGR 261/16
Civil Parish Clayton West Township Clayton West
Name Kaye's Mill
Address

Occupiers Walkers, [illegible]

Contact Investigator CG
Listed Present condition [illegible] Date 26/2/85

Number of principal buildings 1 Date range c.20
Number of principal phases 1 Multi-phase
Situation
Power
Building materials brick, stone
Function 1850 Dyehouse 1929 [illegible]

Spinning mill 1:	Storeys	Bays	Power	Date
Spinning mill 2:	Storeys	Bays	Power	Date
Weaving sheds:	Original	Added	Bays	Date
Wheelhouse:	Internal	Attached		Date
Engine house 1:	Internal	Attached	Detached	Date
Engine house 2:	Internal	Attached	Detached	Date

Boiler house
Economiser
Chimney
Warehouse: Storeys Bays Date
Offices
Other buildings and features [illegible], c.20

Embellishments

Earthworks and water courses: Head race Mill pond Dam
Tail race Reservoir

Documentation

Additional notes

Action

Plate 15 *Example of completed Initial Survey Form* justified on two grounds. First, it would produce a statement of the condition of the industry's buildings in the 1980s, producing an invaluable archive for reference purposes. Second, it would act as a preliminary guide to selection of a sample of sites for further and more detailed study by the RCHME. Because of constraints concerning time, access, and the sheer scale of the initial site survey, and in order to impose a degree of uniformity, an 'initial survey form' was devised for use at each site (Plate 15). The initial survey form was designed to give details of current ownership, general statements about the mill's age and structural evolution, information on individual buildings (including the most prominent, such as multi-storeyed mills, warehouses and sheds) and the provision and development of power through surviving buildings such as engine and boiler houses. The proforma also allowed comments on lesser buildings such as dyehouses and offices, and a brief assessment of the suitability of each site for more detailed recording. This method of recording did, however, have inherent problems and deficiencies. Because of the nature of the survey, and mainly due to constraints of time, access to sites, and the scale of the project, judgments at each site concerning the date and structural evolution were necessarily made quickly and many glaring problems and nuances of interpretation left unanswered. Likewise, ascribing a function to individual buildings (such as 'spinning mill', 'weaving shed', and so on) was adopted as a sort of shorthand reference system. In reality the complexity of the division of processes within mill buildings was immense with, for instance, some 'weaving sheds' built for spinning and some 'spinning mills' being partly used for weaving and storage.

The initial survey was undertaken during 1985 and of the 1,800 sites identified from maps, 1,400 were found to survive and initial survey forms completed for each of them. Where sites no longer survived, an Architectural Records Section – Buildings Index' form was completed, with information about the former location, name, and, if known, a date range, for the site. On the basis of the map evidence and the initial site visits a gazetteer of all known textile-producing sites was compiled, later published as part of a thematic survey of Yorkshire textile mills (see Giles and Goodall 1992, 224-249) [original copies of the initial survey forms are deposited at the National Monuments

Record, Swindon]. The gazetteer was used by the RCHME to conduct more intensive survey based on a 10% sample of all identified sites and a number of key themes (including the evolution of the factory system, changes in the nature of power sources and the development of textile machinery, the structural evolution of mill buildings and the effect of the industry on the landscape) explored through architectural analysis, archaeological recording and consultation of relevant documentary sources.

4.4.3 YORKSHIRE MILLS DATABASE AND CASE STUDY SELECTION

In order to use the information from the RCHME Yorkshire mills gazetteer as a basis for this thesis it was necessary to organise that data in such a way that it could be used to assist in the selection of a sample for detailed recording and analysis as well as providing a corpus of data capable of allowing general statements to be made about the Yorkshire textile industry in order to contextualise the case study sample. The initial survey forms were used to create a database (Microsoft Access) of all known textile-producing sites in Yorkshire, 1780 to 1930. This included most of the information on the initial survey forms, particularly that relating to the location, date, power source and condition and economic branch of each site as well as information regarding individual buildings and structures. The data were entered in to three tables in the database:

TABLE ONE *LOCATION DETAILS*

FIELD	PRIMARY KEY	DESCRIPTION
Entry		Individual identifier given to each site
NBR Number	✔	National Buildings Number (as of January 2002)
Site Name		
Township		
Civil Parish		
District		
County		
NGR		National Grid Reference
X		Easting (six figures)
Y		Northing (six figures)

TABLE TWO *SITE PARTICULARS*

FIELD	PRIMARY KEY	DESCRIPTION
Entry		
NBR Number	✔	
Present Condition		
Listed?		Statutory protection
Number of Principal Buildings		
Start Date		Start of date range for site
End Date		End of date range for site
Number of Principal Phases		
Situation		Topography, location, situation
Economic Branch		Cotton, Worsted, etc.
Embellishments?		
ISF?		Initial Survey Form held at NMR
Archive Type		RCHME Archive type (A-C)
Investigator		Colum Giles or Ian Goodall
Date Investigated		

TABLE THREE *BUILDINGS*

FIELD	PRIMARY KEY	DESCRIPTION
NBR Number	✔	
Building Number		Unique number assigned to *each* building
Building Function		Spinning Mill, office, engine house etc.
Start Date		Start of date range for individual building
End Date		End of date range for individual building

The completed database represents a digital record of the 1,800 or so sites identified by the RCHME during the Yorkshire textile mills survey and is compatible with the published gazetteer of these sites (see Giles and Goodall 1992, 224-249). A digital copy is included as Appendix C. However, a number of points need to be raised concerning the use of the RCHME initial survey forms as the basis for this database.

First, the RCHME gazetteer contains entries for all the sites identified using cartographic sources, whereas the initial survey forms were only created for extant sites

(Giles and Goodall 2003, *pers comm.*). The information on the initial survey forms therefore reflects only those sites existing at the time of the initial survey and there is subsequently a significant lacuna in data for those sites identified from maps but which have not survived. In order to enter those sites which have not survived into the database, thereby making the data about the buildings of the Yorkshire textile industry as complete as possible, the limited information about those sites on the 'Architectural Records Section – Buildings Index' forms, held at the National Monuments Record (NMR), Swindon, along with the initial survey forms, were entered into appropriate fields in the database and the absence of an initial survey form indicated in Table Two. This allowed these sites to be taken into consideration (or selected against) in queries of the mills data.

Second, the completeness of the information on each initial survey form was variable. This reflects the nature and constraints of the initial survey and, perhaps, the individual surveyor. However, it is considered that enough information about individual sites and across the survey forms for general and informed statements to be made about the data and for its use as part of this research.

Third, it is recognised that the initial survey, upon which the database represents a record of the extant buildings and sites of the Yorkshire textile industry in *c.*1985. There is, therefore, the possibility that in the intervening two decades further sites might have become redundant or been demolished. Thus, when case studies were being selected from the database there was an acute need for sites to be visited first in order to evaluate their current condition against that recorded by the RCHME in the 1980s.

In order to refine the basis of this study, the database was used to facilitate the selection of a sample of twelve sites for the detailed recording and analysis of the physical evidence for the development of the factory system of production in the cotton and worsted industries, in Yorkshire between *c.*1780 and 1930. This date range and sectoral focus was dictated by the need to define distinct temporal and industrial parameters for this study in the interests of manageability. Buildings identified by the RCHME between 1770 and 1780 were excluded for the purposes of this research for they largely relate to loomshops and independent workshops and not textile mills *proper* which were principally a development of the period after 1780 in Yorkshire.

The temporal parameters of the study were further refined by dividing the period 1780-1930 into three sub-periods: early (1780-1829), middle (1830-1879) and late (1880-1930) period sites. Four sites were chosen from each of these sub-periods resulting in a total of twelve case studies, a sample equating to 10% of the total number of sites studied in detail during the RCHME Yorkshire mill survey. Although these chronological divisions are purely arbitrary, they serve to split up the long period from 1780 to 1930 thus ensuring that sites chosen for recording are representative of 150 years of mill building activity.

The sectoral focus of the research concentrated on the cotton and worsted industries. These two sectors of the Yorkshire textile industry provide an interesting example of the development of the factory system from similar pre-industrial origins and organisation but, because of the differences in the process employed by each branch, present an ideal opportunity to examine a range of different building and site types between two industries. Furthermore, for a time, the worsted and cotton industries were co-operative, following the rising popularity of mixed worsted and cotton products in the late nineteenth century. Therefore, whilst operating as distinct branches, worsted and cotton enjoyed many similarities and in many instances operations were intertwined.

Worsted manufacture, as we have seen, developed in the pre-industrial period on the basis of the putting-out system which automatically lent itself to the factory system, which was a logical extension of the same organisation structure. In contrast, cotton, Crafts' 'glamour industry' (1989, 425) was not a traditional industry in Yorkshire. The cotton sector also had origins in the putting-out system through its origins as part of the fustian trade, but cotton's industrial pre-eminence was based on new forms of organisation (Berg 1994a, 229). The fact that cotton fibres were particularly susceptible to mechanisation, and a growing import trade in the raw material, catapulted the production of cotton into the industrial arena and almost immediately the industry was operating on the basis of centralised factories. Many of the earliest and experimental mills in the country were built to house cotton production, notably the cotton mills in the Derwent Valley, Derbyshire, and here the development of the Arkwright-type mill represented a new departure in building. The cotton and worsted industries therefore provide examples of two sectors of the Yorkshire cotton industry, one 'traditional' and one' new' which exploited the factory system. Because the route taken to the factory system by these two sectors largely derived from the putting-out system the emergence of factory-based production in the Yorkshire cotton and worsted industries was not affected by different significantly different types of pre-industrial organisation. As different pre-industrial structures tended towards slightly different developments within the factory system of production (for instance, there was a tendency for the woollen, flax and linen industries, for a time at least, to rely heavily on domestic based production; see above p78-85) it was important to select two sectors of the Yorkshire textile industry that exploited factory-based production at roughly the same time and out of similar pre-industrial organisation. This allows developments in factory building in the worsted and cotton industries to be compared and contrasted on the basis of similar industrial origins. In order to fairly represent each sector, two cotton and two worsted mills were selected from each period (early, middle and late).

The actual selection of sites as case studies was also determined by a number of practical issues. A major issue was accessibility. In many cases, in particularly in the case of the earliest sites, mills have been abandoned and survive in a derelict condition. This has obvious health and safety implications. Where sites remain in use access may be prohibited or restricted by further health and safety regulations. It was therefore recognised that producing original measured plans of sites may be very difficult. The selection of sites was therefore dependent on the existence of plans, preferably archaeological, but also historical. Accordingly, all but one of the sites selected had preciously been recorded in detail during the RCHME select survey and measured drawings and plans produced. Access to these plans (and accompanying reports) was granted by permission of English Heritage and the National Monuments Record, Swindon. The only site not included in the RCHME select survey was Gibson Mill, Wadsworth, but as this site is owned by the National Trust, measured survey of the site existed and was made available for the purposes of this research.

Sites were also selected on the basis of their overall archaeological potential. This was assessed during initial site visits to each site prior to any recording and was framed by MAP2 guidelines, which are equally significant in an academic context as they are for commercial archaeological projects (English Heritage 1991). In addition to the factors outlined above, the archaeological potential of a site was broadly defined on the basis of the survival of the evidence as well as the existence of documentary evidence and published sources to allow the historical background of the site to be established.

The twelve sites selected, and the principal reasons underlying their inclusion as case studies, were as follows:

EARLY:

AIREWORTH MILLS, KEIGHLEY
APPENDIX A, A1, pA1-A53

The earliest building surviving at the site is a spinning mill dating from 1808, built as a cotton mill but quickly converted to worsted production after the decline of the local cotton boom. The site developed as integrated mill during the course of nineteenth and twentieth centuries. The 1808 mill is in a derelict condition but full access was granted to the exterior of the building and photographs and plans of the site produced by the RCHME utilised. The 1808 mill is the prime focus of interest at the site but its place in the developing complex was considered. A number of primary and secondary historical sources for the site were available for consultation.

EBOR MILL, HAWORTH
APPENDIX A, A2, pA54-A94

The site originated in 1819 as a worsted spinning mill and although the site developed as a fully-integrated site during the nineteenth century the original mill remained water-powered and unaffected by other structural developments at the site. RCHME plans of the site were made available and a number of published sources consulted. Access was only possible to select parts of the site and therefore only the 1819 mill and subsequent alterations and additions were considered, although the architecture of later buildings at the site (some of which were not accessible and for which existing measured survey did not exist) were considered good examples of late period mill building.

GIBSON MILL, WADSWORTH

APPENDIX A, A3, pA95-A128

This site was selected on the basis of the high rate of survival of original evidence and as a excellent example of a small-scale site which developed during the course of the nineteenth century. Measured survey of the site undertaken by the owners, the National Trust, was made available and full access to the exterior and interior of the site granted. Few historical sources for the site are known, but those that have survived have been summarised in a report produced by the RCHME prior to the redevelopment of the site and which was made available for the purposes of this research.

OLD LANE MILL, NORTHOWRAM

APPENDIX A, A4, pA129-A163

Built as a worsted mill *c*.1825-28, this mill is of considerable interest on account of its excellent survival and its experimental design, apparently built to house spinning and weaving in a single multi-storey building. The mill stands empty and in a derelict condition, but access was granted to the site; some areas were, though, too hazardous to closely inspect. A large number of secondary sources for the site are known as well as a limited number of primary documents all of which were consulted.

MIDDLE:

BRITANNIA MILLS, LOCKWOOD
APPENDIX A, A5, pA164-A204

Comprising two mills built between c. 1830 and 1861, Britannia Mills was built by a woollen manufacturer but the larger of the two mills, Britannia Mill, was built as a room-and-power mill for use by, amongst others, cotton spinners. The site therefore presents an interesting example of two related multi-storeyed mills, both of which spent most of their lives as cotton mills, one built for independent use and the other initially for tenants. The site is not ideal in terms of its origins in the woollen industry but was one of only a handful of middle period mills to which full access was granted and existing RCHME plans made available.

DUNKIRK MILL, HAWORTH
APPENDIX A, A6, pA205-A236

Rebuilt in c.1870, this small worsted spinning mill is a good example of a small-scale mill in a rural setting. Plans of the site already existed and the mill is mentioned in a number of published sources. Furthermore, the mill has remained in the ownership of the same family since the early twentieth century and the opportunity was therefore taken to inspect the mill in the company of the current owner providing some invaluable insights into its past. Textile production ceased at the site in the early twentieth century but the mill remains relatively unaltered.

PECKET WELL SHED, WADSWORTH
APPENDIX A, A7, pA237-A264

Built in 1858 as a speculation, the site is a good example of a cotton weaving mill with additional warehousing and sizing facilities. Full access to the site was granted and existing plans produced by the RCHME made available. A limited number of published and primary sources are known for the site. The site is of particular interest for the interior has been altered little since first built.

SALTAIRE MILLS, SALTAIRE
APPENDIX A, A8, pA265-A286

The mill built by Sir Titus Salt in 1853 is, perhaps, the archetypal mill and is therefore of considerable interest as an example of not only the ideal middle period integrated worsted mill but also because of the input of William Fairbairn in its design, a man who published a series of treatise on general mill design in the mid-nineteenth century. Although some parts of the site were not accessible, but permission was granted to examine much of the remainder of the site. Only the original mill (dating to 1853) was examined as later extensions and the New Mill (built 1868) were not part of the 'ideal' factory envisaged by Sir Titus Salt, Fairbairn and architects Lockwood and Mawson of Bradford. Plans of the site surveyed by the RCHME and plans of the site held by the current owners were made available. The site is well represented in published sources, but original sources and company records were unavailable for consultation.

LATE:

ARDSLEY MILLS, EAST ARDSLEY
APPENDIX A, A9, pA287-A311

Built in 1912 on the basis of the Hennebique system of re-inforced concrete, this worsted mill is a prime example of the last generation of textile mills in Yorkshire and the introduction of new building technology into the industry. Full access to the site was granted as well as plans of the site produced for the current owner as well as those surveyed by the RCHME were made available as well as a company archive of photographs of the site dating back to the mid-twentieth century. Worsted production continued at the site until the late 1980s and since then the site has been used largely for storage - much of the original evidence has therefore survived.

FROSTHOLME MILL, TODMORDEN AND WALSDEN
APPENDIX A, A10, pA312-A338

This cotton weaving mill was largely rebuilt in 1896, although some earlier sheds were re-incorporated into the rebuilt structure. Plans of the site were available for use and full access granted to the interior and exterior. The current owners also made available a limited number of old photographs of the site and a copy of a BBC documentary recorded in the 1960s when textile production at the site ceased. Despite its conversion for use as furniture factory the original fabric has not been substantially altered.

PARK VIEW MILLS, NORTH BIERLEY
APPENDIX A, A11, pA339-A366

Built in 1925 this worsted weaving shed was one of the last textile mills built in Yorkshire. It is notable for its ornamental facade, its innovative design including an internal loading bay, and the fact that it was powered by mains electricity; its plan is therefore liberated from the need to house a motive source of power or system of power transmission. Plans of the site belonging to the owner were made available and used in conjunction with measured survey produced by the RCHME. Limited documentary sources were sourced for the site, most dating from the mid to late twentieth century.

VICTORIA MILLS, WEST VALE, ELLAND-CUM-GREETLAND
APPENDIX A, A12, pA367-A391

Rebuilt after a disastrous fire in 1893 and extended in 1898, this cotton spinning and doubling mill remained in use for textile production until the late 1980s and has since been used as storeroom for architectural antiques. Much of the original fabric remains unaltered. Measured survey of the site produced by the RCHME as well as original architects plans were made available for the purpose of this research.

4.4.4 RECORDING STRATEGY

This methodology is specifically concerned to look at the use of architectural form, style and symbolism and spatial organisation at each site and the recording strategy employed reflects this intent. An essential part of those analyses is the production of a structural sequence, applying the principles of stratigraphic analysis to understand a building's construction and subsequent structural evolution. It is important to note here that, where possible, at each site the entire premises were studied and therefore the use of the term 'mill' refers to the whole site and not just a single building. This approach was adopted in the field so that later analysis could focus on entire sites and individual buildings as appropriate, allowing the optimum amount of evidence to be recorded.

Although each site was selected on the grounds of date (early, middle or late), in practice it was clear that the majority of sites had inevitably undergone alterations since construction, particularly in those instances where the site has been put to alternative use in modern times. In order to establish the original form of each site and any significant phases of alteration or expansion whilst the site was still producing textiles, it was essential to produce a structural sequence for each building and principal phases in that building's history to be clearly be defined.

The application of stratigraphic analysis to standing structures has proved controversial, not least because many of the basic principles of the 'Harris' system simply do not apply (Davis 1993 after Harris 1989; 1993). Stratigraphic recording, applied to buildings, aims to provide 'a systematic dissection of a structure in its component phases augmented by equally systematic recording of other aspects such as building materials and contexts of construction' (Grenville and Morris 1991, 3). Part of the problem in applying stratigraphic analysis to above ground archaeology concerns the definition of a stratigraphic unit (see, for instance, Wrathmell 1990; Davis 1993; Roskams 1999). This thesis adopts a position increasingly adopted by excavating archaeologists and further developed in relation to the archaeological study of standing structures by Jones

(1997). Stratigraphic units are seen to be flexible entities defined by the recorder as materially embodied 'actions' or events'. In practice they are identified as being physically consistent in a manner, which distinguishes them from their surrounding elements and by the fact that they constitute an entity in basic functional terms (Jones 1997, 43). Thus, depending on the research agenda and recording strategy employed a stratigraphic unit can comprise a single floorboard or an entire, pre-fabricated timber frame (Giles 2000, 40). For this thesis, a basic understanding of the development of the site was required and therefore, the definition of 'actions' and 'events' were established at a very broad level.

For each site, existing plans (most drawn by the RCHME in the 1980s) and historical sources (such as architects plans) were consulted and phased on-site using the principles of stratigraphic analysis to identify principal phases of construction and use at each site, and, crucially, to create a set of plans susceptible to spatial analysis (see below, section 3.3.4). The principal interest was directed towards the original form of each mill being recorded, as it was important to establish the earliest surviving phase of construction in order to fulfil the criteria of selecting four early, middle and late period mills. However, changes to the mill during its lifetime as a textile factory were also of interest and phasing was undertaken in order to define the principal structural changes and development at each site, allowing some comment to be made about the significance of later alterations to the spatial form and character of each mill.

Plans of each site were digitised using AutoCAD in order to standardise their appearance, and the drawing conventions used broadly followed specifications outlined by the RCHME (1996). However, in order to emphasise access between spaces, doorways and other openings were shown on plans as open permeabilties. Because many of the sites studied are less than two hundred years old, and for much of their life were used for the same function - the production of textiles, the number of phases at each site was relatively small, usually numbering less than four with the final phase more often than not relating to modern adaptations and re-use and therefore outside of the temporal limits of this thesis. The phasing of plans at each site was accompanied by a thorough archaeological and architectural description of each site with particular attention paid to evidence for the sequence of construction, techniques of construction, organisation of machinery, power sources, power transmission and provisions for the workforce such as sanitation. Particular emphasis was paid to points of access into a site and to individual buildings and internal access routes. For most of the sites a report written by the RCHME already existed and this was used as a basis for the site descriptions. However, care was taken to re-assess all judgements made by the RCHME and in many instances a re-evaluation of the site was instrumental in providing new or challenging evidence. A systematic and detailed programme of 35mm black and white photography and digital photography accompanied the written description and plans. Where possible stratigraphic features, evidence relating to power sources, power transmission, machinery and the use of the building were photographed.

In addition to the archaeological recording of each site in the sample, documentary research was conducted using a variety of sources including indentures, wills, deeds, architect's plans, rate books, insurance policies, written accounts, early photographs, maps, and so on. These sources were particularly important in allowing sites to be phased and a qualitative understanding of the architecture of each site to be established. In addition, and where appropriate, existing oral histories or accounts of life in the Yorkshire textile mill were consulted, whilst visits were made to a number of sites where traditional working has been maintained or recreated, in order to witness the physical reality of a working textile mill. These sites included Quarry Bank Mill, part of the Styal Estate, Cheshire (National Trust) and Queen Street Mill, Burnley. At both sites, traditional working methods are followed and original machinery continues to be operated. Whilst the interior arrangement of processes at Quarry Bank Mill has been altered to allow easier visitor access, the layout of machinery on each floor still reflects the traditional layout of machinery and processes within a multi-storey mill building. At Queen Street Mill, Burnley, the weaving factory has been left exactly as it was when fully-operational and, therefore, is perhaps the most reliable source of comparable information in the north of England.

Other sources included published volumes on industrial and contemporary architecture, which were consulted in order to establish the significance, if any, of the form and style of the textile mills studied. Particular attention was paid to the extent to which formal aspects of the mill played a role in the regionalisation of the *locale* and the material structuring of social practice in the workplace. Particularly useful were transcripts of oral history interviews recorded by the Bradford Local Studies Library. Although the majority of interviewees had worked only in twentieth century factories their experiences of the workplace were nonetheless important. Furthermore, given that most of these individuals had worked in mills that had been built during the industrial revolution their comments were very informative. Unfortunately, few of the interviewees had worked in any of the sites selected as case studies although a number had either worked at or mentioned Saltaire Mills, Saltaire. Nonetheless, these interviews formed an invaluable source of information as, will become apparent in the later chapters, the ubiquity of mill design and tendency for the same elements of planning to be used at different sites meant that many of the references to working in the mill in a twentieth-century context in the oral histories are applicable to earlier mills.

A major issue in the study of each site, and at the heart of this enquiry into the social dimensions of production, was the establishment of those elements of mill design, in both internal spatial organisation and more stylistic and formal attributes, which may be considered to be socially significant. It was therefore necessary to discriminate between factors relating to technology and work organisation, and, in a broader sense, between function and fashion. Central to this was the identification and examination of the evidence for the differential use of space by goods and processes, and by the workforce. In order to establish a rigorous means of differentiating between these features an archaeological technique specifically designed for the recording of industrial complexes known as 'process recording' (Malaws 1997) was adopted.

Process recording was developed as a means of understanding the nature of industrial sites – it was primarily concerned with sites where production was still undertaken and predominantly favoured a technological approach. However, it has potential as a basis for understanding sites where production has ceased and, by virtue of its attention to the technological and functional, as a means of discerning those attributes in an industrial complex that might be considered significant to our understanding of the social dimensions of production on the basis that they have no apparent logic in a technological or functional context.

Process recording involves the consideration of the whole of an industrial site and the processes and products that it houses. Attention is paid equally to 'input' (raw materials, transport systems, power sources), 'process' (machinery and techniques, the use of 'standard' or other applications, economics of operation, nature of the material and market requirements), and 'output' (storage, loading and transportation of the end product to markets). Malaws (1997) used this recording strategy to produce schematic drawings, flow charts and a comprehensive description of industrial sites based on a combination of archaeological and archival research and analogy with other sites. More recently the technique was revisited and renewed emphasis placed on the importance of establishing the human experience of working in industrial buildings (Malaws and Badcock 2004).

For the purposes of this thesis, a version of process recording was developed with the aim of producing flow charts and a general description of the processes undertaken in the textile mills studied as far as is possible to reconstruct. As the majority of the sites selected for detailed study are no longer used for the production of textiles and, for the most part, have been altered for modern use, process recording was used to provide a general understanding of the technologies and processes at each site. Analogy with other sites and contemporary descriptions and published treatises on millworks formed an essential part of this understanding. In addition to this standard form of 'process recording', the movement of raw materials and goods around the mill was also analysed. This took the form of gamma maps drawn to reflect the movement of goods rather than people (see below, section 3.3.4) in order to differentiate between areas of the factory and aspects of the mill's design that reflect provision for the movement of workers as opposed to products.

This analysis of technology and function proved a vital source of information allowing those attributes of mill design that may be termed 'purely functional/technological' to be established and thus allowing those other attributes that might be considered to have responded to social factors to be identified. This recording strategy therefore had explicit parallels with the Markus' 'three structures' in the textile mill – social, spatial and power transmission (1993, 264) and offered an archaeological means of examining each of these structures and their material manifestation in the textile mill.

4.4.5 SPATIAL ANALYSIS OF THE TEXTILE MILL

Examination of the spatial organisation of the textile mill adopted an analytical procedure based on the formal analysis of space developed by Hillier and Hanson (1984; see also Hillier 1996; Hanson 1998) known as 'access' or 'gamma analysis'. This analytical technique examines boundaries and permeabilities between spaces and the resulting patterns of access within a building.

The primary units of gamma analysis are the cells that make up premises. A cell represents bounded space. Put otherwise, each bounded space or room in a building may be conceived as an individual cell having characteristic permeability or access properties where a doorway, for instance, breaches the boundaries of that cell. Combinations of these spaces constitute a complex or a system, or in architectural terms an individual building or premises, and those complexes with similar spatial configurations may be considered as building genotypes.

In order that the spatial configuration of a complex be analysed, it is necessary to construct a 'Gamma Map'. Gamma maps act like dissection, the premises under study being 'sliced' down the middle and then 'pinned-out', making their internal spatial structure visible and open to examination. This is achieved by conceptualising each cell as a point, and representing them on the gamma map as a n individual point. A line or lines leading to and from that point indicate the spatial relationship of that cell or point, in terms of its permeability, to other spaces. Crucial to this process is the definition of spaces within a building. Spaces may be horizontal, such as a standard room, or vertical, such as staircase. This thesis recognises a position wherein spaces are marked by either physical permeabilities which can be opened and closed (such as doors) and more conceptual divisions based on an awareness of moving into another space.

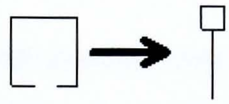

Plate 16 *Example of a Unipermeable point and its representation on a gamma map*

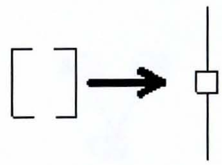

Plate 17 *Example of a Bipermeable space and its representation on a gamma map*

A space or cell with a single permeability, a *unipermeable point*, will only have lines going to it and would be represented on a gamma map as a single point with only a single line of access (Plate 16). A *bipermeable point*, a cell with one or more entrances or exits (permeabilities) will be represented on a gamma map as a point with two or more lines of access leading to and from it (Plate 17). All gamma maps are constructed using an exterior space as a carrier point, represented by a box containing a cross. All gamma maps are constructed on these principles. A *Justified Gamma Map* is a method by which the permeability structures represented on a gamma map are set out in such a way that they may be analysed in a systematic fashion. The first stage is a representational process. Each space in the premises is assigned an identifying number (an *Identifier*; labelled top to bottom, left to right throughout the premises). Each space is then assigned a depth based on the minimum number of steps that must be taken to arrive at that space starting from the carrier - a *step* representing a movement from one space to another. All spaces of the same depth are placed horizontally in a line above the carrier. The lines representing direct connections are drawn in where appropriate, irrespective of their length.

The great advantage of justified gamma maps is that they make the syntactic properties of symmetry, asymmetry, distributedness and nondistributedness very obvious and permits their quantification. Symmetry within a justified gamma map indicates spaces with direct access to other spaces without having to pass through other intermediary spaces; asymmetry denotes spaces whose relations are only indirect. Two spaces will be symmetrical to each other if *a* is to *b* as *a* is to *b* with respect to *c* - neither *a* or *b* control access to each other. Conversely, *a* and *b* would have an asymmetric relationship if *a* is not to *b* as *b* is to *a* - that is, one controls access to the other via some third space.

Further spatial relationships may also be discerned from a justified gamma map. Two spaces may be considered to have a distributed relationship if there is more than one independent route from *a* to *b* including passing through a third space, *c*; that is, a space that has more than one locus of control with respect to another space. An increase in the number of rings in a complex therefore results in a greater distributedness across that complex. In contrast, two spaces will have a nondistributed relationship if there is some space through which any route from *a* to *b* must pass. These syntactic relationships may easily be illustrated. Plate 18a shows *a* and *b* in a symmetric and distributed relationship with respect to *c*; Plate 18b shows *a* and *b* in a symmetric and nondistributed relationship with respect to *c*. Plate 18c illustrates *a* and *b* in a asymmetric and nondistributed relationship with respect to *c*, whilst Plate 18d shows *a* and *b* in a symmetric relationship to each

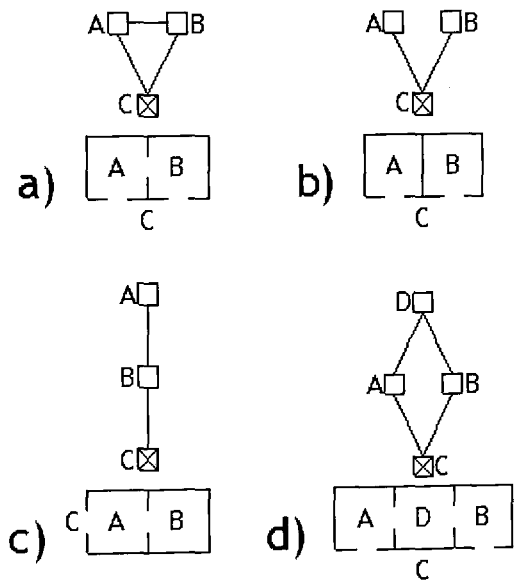

Plate 18 *Examples of syntactic relations represented in gamma maps (after Hiller and Hanson 1984, 148-9*

other with respect to *c*, but *d* is has an asymmetric relationship to both with respect to *c*.

The great advantage of justified gamma maps is that they allow the quantification of building plans. Acting like a graph with arbitrary values assigned to each cell, it is possible to calculate values expressing symmetry, asymmetry, distributedness and nondistributedness.

The symmetric and asymmetric relationships within a complex may be quantified. By calculating the Relative Asymmetry (RA) of a complex from different points within that complex, it is possible to indicate the extent to which a particular space is segregated from or is integrated within the spatial pattern of the complex as a whole. RA values are numerated by assigning depths to each space within the justified gamma map with respect to the carrier point. Those spaces that are one spatial step from the carrier are given the value '1', those two steps away the value '2', and so on. These values, or depths, are then totalled and divided by the sum figure of the number of spaces in the system less one (the carrier space), giving the Mean Depth (MD). Relative Asymmetry is then calculated by the following equation (where k is the number of spaces in the complex):

$$\textit{Relative Asymmetry} = \frac{2\,(MD - 1)}{K - 2}$$

By repeating this procedure for each space represented on the justified gamma map (that is individually calculating values using each point in turn as the carrier point), a range of values measuring the integration of each point within the system are obtained. This procedure results in a range of values between 0 and 1, with low values indicating spaces from which the complex is shallow - that is to say, that those 'shallow' points tend to be integrated within the system. Conversely, high values indicate spaces that tend to be segregated from the system, and may be termed as 'deep' spaces. The determination of whether a RA value is 'low' or 'high' is derived from the average RA value of the whole complex.

The calculation of relative ringiness values allows the numerical expression of the distributedness and nondistributedness of premises. The relative ringiness of a complex, the relative ringiness of a single point (space) in the gamma map, and the relative ringiness from a point (space) in the gamma map may be calculated thus:

Relative Ringiness of a Complex -

<u>*Number of distinct rings observable*</u>
Maximum number of planar rings for that number of points
(2p-5: where p is the number of points in the complex)

Relative Ringiness of a Point (RR of) -

<u>*Maximum number of independent rings that pass through that point*</u>
Maximum number of rings that could pass through that point
(p - 1 : for p points since any further lines from any further point can only repeat a link that has already been made)

Relative Ringiness from a Point (RR from) -

<u>*Relative Ringiness of the complex X 1*</u>
Mean distance that the point is from each of the rings in the complex
(adding 1 to exclude zeros)

The calculation of 'RR of' and 'RR from' values allows the quantification of ringiness in the complex and with respect to given spaces in that complex. Increasing ringiness in the complex will indicate increased distributedness, both of the complex as a whole and of those points within it affected (or unaffected) by those rings. A high 'RR of' value indicates a spatial relation, with respect to another space with more than one locus of control. A high 'RR from' value is symptomatic of the extent to which a space or point is integrated in the distributed/nondistributed parts of the complex; a high value indicates that the space is part of the distributed part of the complex.

However, the calculation of ringiness has largely been dropped within the space syntax community within recent years and instead the distributed and nondistributed nature of a complex is largely taken as a visual measure from gamma maps or, increasingly common, through the use of computer software. This methodological change reflects the fact that the measure of RR relationships is useless in complexes in which there are no rings and consequently does not allow a scientific comparison to be made between complexes with and without rings. Furthermore, the extent to which an individual space shares a distributed or nondistributed relationship is also reflected in its RA value for a space with many links to other spaces is naturally both more integrated in the complex (it thus has a low RA value) and has a distributed character (Julienne Hanson, *pers. comm.*). Indeed, the same syntactic properties are as visible from the gamma map alone and through the quantification of the number of neighbouring spaces each individual space or cell has. Following this methodological advance in the field of space syntax analysis the decision was taken only to calculate RA values and the RR value of the complex as a whole. The distributed and nondistributed character of individual complexes and spaces was considered from visual examination of gamma maps alone and through the calculation of the number of neighbours for each individual space.

4.4.6 GAMMA ANALYSIS, ARCHITECTURE AND SOCIAL PRACTICE

The relationship of the spatial patterns revealed through gamma analysis to social practice has been at the heart of many of the criticisms levelled at the work of Hillier and Hanson (see, for instance, Leach 1984; Brown 1990; see Chapter Three). However, gamma analysis offers a means of approaching the matter of the social use of space for it provides a means of approaching the spatial character of buildings and resulting observations may be used to theorise archaeological other theories of social space.

The very nature of the gamma map and the measurement of RA values defines some areas of a building as 'private' whilst others are seen as 'public' and this has clear parallels with Giddens' regionalisation (1984) of the *locale* (the building) and more specifically the idea of 'front-' and 'backstage' areas within which prescribed social action takes place (Goffman 1959). The concept that access to spaces within a building is controlled and socially specific is of considerable interest in this research, which is concerned with establishing the ways in which the textile mill as a physical entity was responsible for the structuring of labour relations and the creation and maintenance of power structures and hierarchies. In this way, gamma analysis is being applied to the textile mill with some *a priori* notion that the form of the mill responded to the need to supervise and control the workforce and to create a working environment suited to minimal transaction costs.

However, it has been argued that spatial analysis alone can not accurately reflect social practice and Foster (1989) stressed the importance of establishing the context of built space, using spatial analysis in a cumulative effort with other evidence for architectural form and social function. This has clear parallels with the idea that a buildings form, function and space have meaning in the field of social relations (Markus 1993a, 30) and suggests that human experience of a building is as dependent on the configuration of space as it is on the more qualitative aspects of architecture.

This has led some practitioners to consider the spatial form of buildings in the context of other formal evidence, such as the stylistic and symbolic architectural treatment of a structure (see, for instance, Foster 1989; Schofield 1994). This kind of approach, which will be developed by this thesis, has two clear advantages over straight spatial analysis. First, it can contribute to an understanding of how spaces were used. For instance, a 'frontstage' space that is elaborately decorated with symbolic motifs about the owner of the building is a more convincing example of a 'public' space than the same space studied only from a space syntax perspective. Second, a qualitative approach to social space not only provides context for spatial analysis, but also allows the ways in which buildings convey wider social meaning to be assessed. Such statements may be made at the level of individual spaces, thus supporting or refuting observed spatial patterns and interpreting the significance of those patterns in terms of social practice, or may be made at the level of the building as a whole and its significance as a physical entity within a wider physical and social environment. For the purposes of this research, a basic summary of the principal architectural characteristics of each site will be given with particular attention paid to the ways in which stylistic motifs are used, if at all, across each site.

CHAPTER FIVE
THE TEXTILE MILL - FUNCTIONALITY RECONSIDERED

> '*Explanations of technological change provide one route to understanding industrial growth and structure during the eighteenth and nineteenth centuries. But equally important was organizational [sic] change*' (Berg 1994a, 189)

Central to Markus'(1993a) model of the factory is the idea that both technological and social factors played an important role in the emergence and development of the factory. According to his view, both determined the physical form of the factory and, in the fully-evolved factory, these factors shared a symbiotic relationship that defined the factory as a distinctive building type. This position suggests that the mill had practical and social functions and this presents a challenge to traditional views of the factory and industrial architecture *per se* which have only explored the most functional of attributes and have simply seen the factory as a physical structure housing the processes of production. In these models, the primacy of technology has been emphasised and the function of the factory reduced to the most literal of interpretations.

However, and in contrast, there is clear archaeological evidence to support Markus' model and the social dimensions of the factory may be broadly divided in to two main categories. On the one hand, the spatial organisation of the factory can be seen to have dictated labour and wider social relations. Alternatively, though not unrelated to the spatial qualities of the mill, the architectural treatment of the mill can be seen to convey a number of different social messages. It is an understanding of the factory based upon these two categories that this thesis seeks to develop and the following two chapters (Chapters Six and Seven) will be specifically concerned with their detailed discussion. This demonstration that the factory had a social as well as a practical function demands a revision of our understanding of 'functionality' in the context of the factory system.

However, whilst this thesis is specifically concerned with exploring the archaeological evidence for the social dimensions of production and consequently advocates a shift away from dominant technological narratives, it neither seeks to disprove or ignore the role of technology in the emergence of the factory systems of factory buildings. Indeed, to omit technology from our interpretations of the industrial revolution would be to be neglect as vital a part of the story in much the same way that existing studies of the factory have neglected those vital human elements. To this end, the work of T.A. Markus presents a way of theorising both the social *and* technological aspects of mill design.

The remainder of this chapter will therefore be concerned with exploring the archaeological evidence for the ways in which the physical form of the mill responded to purely technological factors. Much of this evidence is drawn from the case studies, presented in Appendix A. There is a clear logic to this diversion in to the realms of technology. First, it establishes two of the fundamental 'fields of discourse' that the factory can be seen to have emerged within – namely technological innovation and the emergence of large-scale industry. Second, and most importantly, the technological aspects of the mill provide some absolute constraints and are therefore taken first. It is through identification of these technological attributes that we can begin to establish those elements of mill design which responded to other factors beyond technology, namely the social dimensions of factory-based production. Third, it will also demonstrate the inherently restricted and descriptive nature of a technological paradigm to our understanding of the mill. Indeed, a vast corpus of contemporary literature dealing with all aspects of technology in the mill, already exists, written by influential millwrights (for instance, Fairbairn 1861; 1863; 1871; 1874), major observers in the field of mill engineering (*cf.* Saxon 1891; Anon 1894; Nasmith 1894; 1900, 1909; Sington 1897; Potts 1914) and early industrial historians (such as Baines 1835; 1877; Ure 1835; James 1857; Marsden 1886) and this provides a historically derived technological account of the mill and has, traditionally, been seen as an adequate interpretation in itself. However this chapter will seek to establish a similar understanding from archaeological evidence.

It is acknowledged that the following discussion by no means represents an exhaustive exploration of the material expression of technological factors in the textile factory. It will concentrate on the role of motive power sources, power transmission, the layout of processes and machinery, technological developments in machinery and the movement of materials and goods about the textile mill with an emphasis on their implication for the physical form of the mill. Archaeological evidence collected during the course of this thesis will inform the greater part of the discussion but reference will be made to the work of the former Royal Commission on the Historical Monuments of England (see, for instance, Giles and Goodall 1992; Williams and Farnie 1992; Calladine and Fricker 1993) which has already established a comprehensive understanding of the close relationship between the physical form of the textile mill, technological innovation and developments in structural engineering.

5.1 SOURCES OF POWER

5.1.1 WATER POWER

The mechanisation of the manufacture of textiles played an important role in the transformation of the industry from its domestic base to the factory. Central to the development of increasingly sophisticated and large machinery was a central source of motive power. Whilst it is undisputed that many of the fundamental technological developments in the textile industries occurred during the era of hand and animal power - for instance, Cartwright's abortive experiments for a powerloom used power from a bull, Paul and Wyatt used donkeys to drive their roller frames, and many early spinning mules and jennies continued to be operated on a hand-powered basis into the second quarter of the nineteenth century (English 1969; Giles and Goodall 1992, 123-124; Aspin 1981) – it is clear that the development of machinery within the industry increasingly demanded more effective sources of motive power. A point in case was Arkwright's Water Frame which could only really be used on a relatively large-scale and required a central power source (Williams and Farnie 1992, 8-9). The application of power to industrial processes therefore provides one context within which to set the emergence of the factory system, leading to the development of highly organised production and specialised labour (Clark 1999, 289).

The archaeological evidence from the textile mill bears out the primacy of motive power within the emergent factory and is a crucial element in understanding the physical location of the factory and many aspects of its spatial development.

Water-power was central to the development of early factories and it is clear that both the form of the mill and adoption of the waterwheel as a principal source of motive power at least partly followed an existing tradition of mill building in pre-industrial England. Water powered corn and fulling mills are known from the West Riding of Yorkshire from as early as the twelfth century (Jenkins 1975, 8) and by the sixteenth century the technology of the waterwheel was well established (Clark 1999, 288). During the eighteenth and nineteenth centuries the efficiency of the waterwheel increased leading to a rise in average horsepower from *c.*10 hp before 1700 to around 100 hp in the early nineteenth century. Improvements were made to the general construction of the wheel, to the shape of the buckets, and, crucially, to the means of taking drive from the wheel (Tann 1970, 60-1; Clark 1999, 288). Chief was the development of the suspension wheel. Earlier wheels had transmitted drive directly from their axle, weakening the structure of the wheel due to the inherent torque in the shafts powering the mill. In contrast, the axle of the suspension wheel did little but support the structure of the wheel whilst drive was

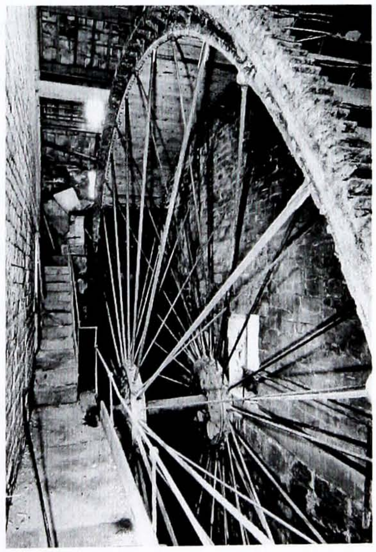

Plate 19 *Example of a suspension wheel at Lumb Mill, Warley **(BFO62712)**, with toothed-circumference wheel visible*

achieved by a ring of cogs inside the circumference of the wheel that drove a smaller cog beside the wheel (Plate 19). Either directly, or through gearing, this smaller cog transmitted power to the rest of the mill. Recent research has suggested that William Strutt at his Belper Mills developed the earliest suspension wheel before 1811 when it was described in *Ree's Cyclopedia* (1811) (Gifford 1994).

The Yorkshire textile industry largely developed on the basis of water power and the high proportion of mills distributed along becks and rivers is evident by the early nineteenth century. The search for a plentiful water supply often led to the construction of mills in remote valleys were fast moving water not prone to draught was a ready commodity. Thus, the early distribution of early water powered mills reveals a largely rural and dispersed organization of the industry, with a linear pattern of several mills along the same watercourse (see Plate 10, p87). Traditionally, it has been suggested that the advent of steam power not only brought about the decline of the waterwheel in the industry but also enabled the relocation of the industry into a largely urban setting capitalising on existing and emerging market centres and centres of the population. However, the archaeological evidence from Yorkshire suggests that despite an apparent relocation in the industry, water continued to be an important source of power. New waterwheels were installed as late as 1882 at Greengate Mills, Keighley, and in many cases, more efficient water turbines were introduced rather than the wholesale replacement of wheels with steam engines. In fact, at Dunkirk Mill, Oxenhope and Gibson Mill, Wadsworth, the later steam installations that superseded the original waterwheels were themselves superseded by water turbines in the late nineteenth and early twentieth centuries bringing the use of water power full-circle.

The archaeological evidence therefore indicates that steam power did not necessarily bring about the demise of the waterwheel. Indeed, even steam installations required a source of water, albeit not a fast flowing or steady flow (Holden 1999). Waterpower continued to have advantage over steam installations for a number of reasons – steam engines were expensive to install and early models were often unreliable and less powerful than contemporary waterwheels (Giles and Goodall 1992, 125). Cossons

(1987) has argued that the declining popularity of the waterwheel actually had more to do with the diversion of water for land drainage and urban domestic consumption, than in the inefficiency of waterpower itself and the advantages of steam power. A classic example of these tensions is seen at Dunkirk Mill, Oxenhope (**A6**), where the Leeshaw Beck was dammed some distance above the height of the mill to provide a new reservoir for the Bradford Corporation in 1879, the original course of the stream and a flow of water from the reservoir was maintained ensuring a supply of water for Dunkirk Mill and other mills further down the valley, many of which remained water powered.

The efficient harnessing of water power depended on two major features: the means of supplying water to the waterwheel, and the waterwheel itself. Both had a profound effect upon the physical and spatial form of the mill.

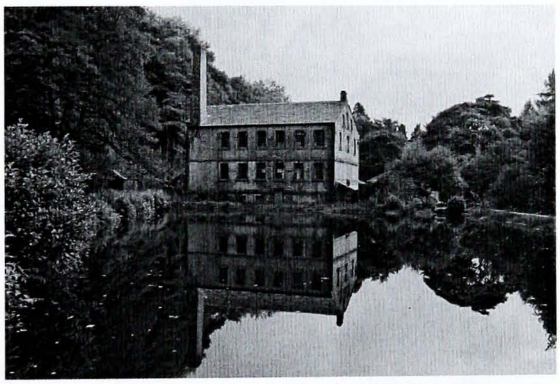
Plate 20 *Gibson Mill is built directly upon the edge of the mill pond; the relationship between power source and factory is thus very close*

Investment in a system of water management could be expensive and sometimes the scale of the work involved was impressive; frequently it amounted to a greater investment of capital than the mill building itself. Few mills could be built to take advantage of a natural fall of water and so systems of water management were devised, usually involving the construction of a mill dam and the flooding of a mill pond to create a head of water. At Gibson Mill, Wadsworth (**A3**, Figure 3.1: A96), and Dunkirk Mill, Oxenhope (**A6**, Figure 6.1: A207), the mill is built up against the mill dam, bearing out the close relationship between the mill building and its water supply (Plate 20). At Gibson Mill, a further reservoir is located above the main mill pond and could be used to fill the lower reservoir when required, either during periods of drought or when production was running at a maximum. At some mills, like Ebor Mill, Haworth (**A2**, Figure 2.1: A56), the creation of the mill dam involved even more investment. Waterpower to the earliest mill at the site was provided by a large millpond above a tall weir and crossed by a road bridge built by the mill owner. The means of supplying water to the mill was therefore integral to the mill site and a major consideration in the choice of a site.

Crucially, the presence of an available source of water had implications for the later spatial development of the site. At Aireworth Mills, Keighley (**A1**, Figure 1.2: A8), the original and simple system of water management was superseded by a vast mill dam in the 1840s, the position of which was to affect the later development of the site with new building possible only to the north and east of the early water powered mill. One means of counteracting this problem was to divert water from the mill dam via a mill race and pentrough onto the wheel. Thus at Ebor Mill, Haworth (**A2**, Figure 2.1: A56), water entered the mill at its eastern end whilst the course of the Bridge House Beck flowed past the mill to the west. Conversely, at Gibson Mill, Wadsworth (**A3**, Figure 3.1: A96), water flowed onto the wheel directly from the millpond but left through a subterranean tailrace emerging some distance downstream allowing uninterrupted use of the mill yard.

However, the positioning of the waterwheel itself had the greatest implications for the spatial form of the mill. Waterwheels were usually located either against or within the buildings that they powered (Giles and Goodall 1992, 126) and this led to a number of possible arrangements (Plate 21). At Dunkirk Mill, Oxenhope (**A6**, Figure 6.1: A207), and Aireworth Mills, Keighley (**A1**, Figure 1.3: A9), an end wheelhouse was favoured. The end

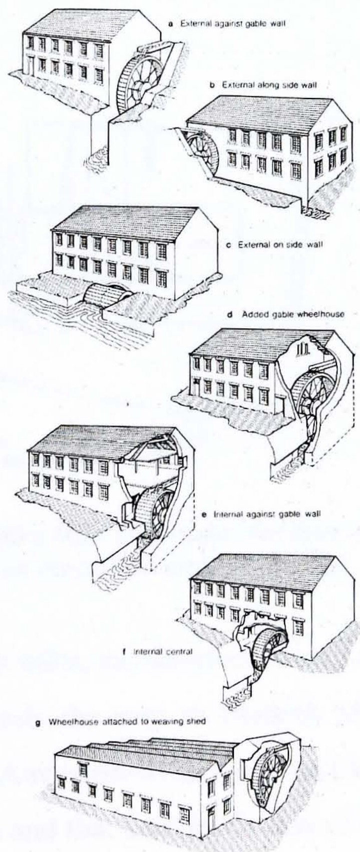

Plate 21 *Possible positions for waterwheels in the Yorkshire textile industry (Giles and Goodalls 1992, 127)*

wheelhouse had substantial benefits over other forms. By incorporating the wheel at one end of the mill, the remainder of the space in the mill was left free for the housing of machinery. Furthermore, the end wheelhouse permitted easy expansion. At Gibson Mill, Wadsworth (**A3**, Figure 3.2: A99; Figure 3.4: A108), a later weaving shed was built to the west of the original mill creating a central wheelhouse. However, this central position allowed drive to be taken from the wheel to the new shed through a wall box created in the west wall of the mill and without interrupting either the existing wheel or system of power transmission. At Ebor Mill, Haworth (**A2**, Figure 1.7: A27), the end wheelhouse also became centrally placed when extensions were made to the east end of the mill. However, the new extensions were used to house offices and storerooms thus allowing an extension of the facilities at the mill, but did not result in any change to the existing power source or means of power transmission.

The wheelhouse, regardless of its position constituted a major structure within the mill. It was common for the walling around the wheel housing to be thickened and more often than not it occupied the basement, ground floor and sometimes first floor of the mill. Given the scale of the wheelhouse and the investment required to provide a suitable housing, an adequate water supply and the technology for the receiving of drive from the wheel, it is not surprising that in many rebuilt mills, the wheelhouse and was retained from the earlier structure. This was certainly the case at Dunkirk Mill, Oxenhope (**A6**, Figure 6.2: A210) (Plate 22), whilst at Aireworth Mills, Keighley (**A1**), differences in the stone work around the wheelhouse and that used in the rest of the rebuilt mill suggests its reuse from an earlier mill.

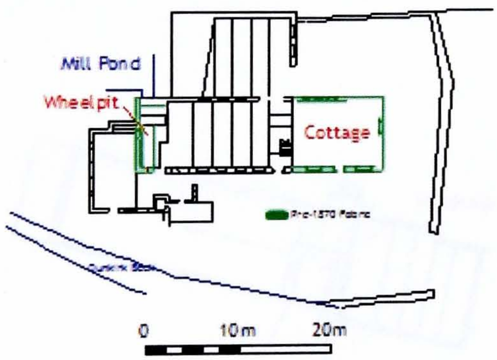

Plate 22 *Dunkirk Mill, Oxenhope: the later mill incorporated an early19th century wheelpit*

This adaptive reuse is interesting for two reasons. First, it indicates that the development of the mill was not a straightforward and an altogether progressive process. Older forms and technologies could inform the design even of new mills. Second, and perhaps more importantly in the context of this thesis, it suggests that the mill owner exercised economic stringency and that where possible older features which would have been costly to replace, were retained. This, as we shall see later, contrasts with the evidence for other features of the mill that were subjected to rebuilding or extension. For instance, at Aireworth Mills, Keighley (**A1**), the apparently earlier wheelhouse was subsumed into a mill entirely typical of its date with prolific architectural details such as a bellcote and clock that were contemporary with the new building. This is of particular interest for it indicates that whilst functional aspects of the mill were retained and reused there was a concerted attempt to ensure that outwardly the mill appeared contemporary and adhered to contemporary styles of mill architecture. This point will be addressed again later, particularly in the context of the discussion of mill architecture in Chapter Seven.

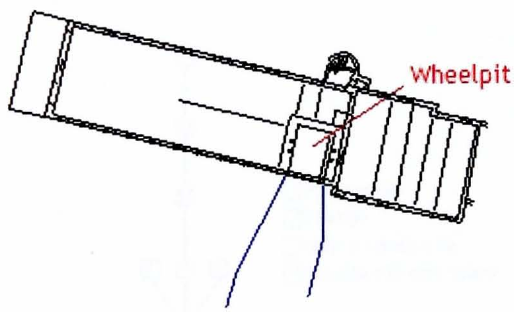

Plate 23 *The wheelpit at Aireworth Mills, Keighley occupied almost a third of the ground floor of the mill*

The size of the waterwheel necessarily meant that the wheelhouse could occupy a significant proportion of the available space within the mill, though this was, of course, not an issue in the case of external waterwheels. At Gibson Mill, Wadsworth (**A3**, Figure 3.3: A101), Ebor Mill, Haworth (**A2**, Figure 2.3: A61), and Aireworth Mills, Keighley (**A1**, Figure 1.3: A9), the wheelhouse occupied between one quarter and one third of the ground floor (Plate 23). At Dunkirk Mill, Oxenhope (**A6**, Figure 6.2: A210), the thinner wheel occupied only one bay of the mill, but was significantly taller than the other, squatter examples and thus rose through the ground and first floors of the mill, reducing the available working space on all but the attic level. The extent to which the waterwheel was separated from the rest of the mill was varied. The ultimate separation was an external wheel. Internal wheels might be housed completely within their own spaces, like at Ebor Mill, Haworth (**A2**, Figure 2.3: A61); here the wheelchamber was accessible only from the exterior of the building and it communicated with the rest of the mill by purely mechanical means (Plate 24). In contrast, at Aireworth Mill, Keighley (**A1**), and Gibson Mill, Wadsworth (**A3**), the wheel was apparently visible from the mill interior, with only a wall between the two spaces to the level of the axle bearings.

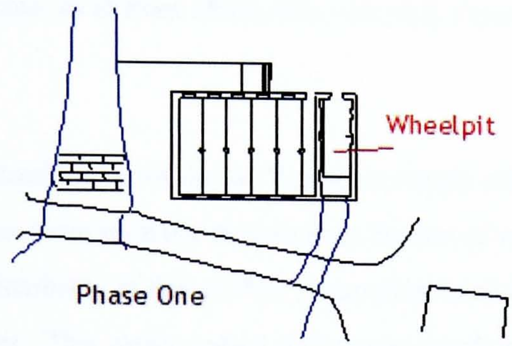

Plate 24 *The wheelpit at Ebor Mill, c.1819, was entirely separated the rest of the building and had its own entrance*

Spatially, the different arrangements of the waterwheel results in three patterns: either the wheelhouse is completely isolated from the rest of the spatial complex, as at Ebor Mill, Haworth (**A2**, Figure 2.3: A61), or is simply tacked onto the ground floor working space, either as a separate space, as at Dunkirk Mill, Oxenhope (**A6**, Figure 6.2: A210), or simply as part of the ground floor working space and therefore not spatially distinct, as at Gibson Mill, Wadsworth (**A3**, Figure 3.3: A101). The tendency is, then, for the waterwheel to be located within its own space and, in spatial terms at

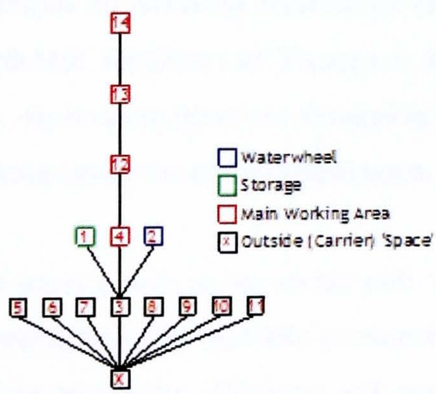

Plate 25 *Typically, the waterwheel at Ebor Mill, Haworth, occupies an isolated position in the spatial complex of the mill*

least, was distinct from other spaces at the site, as at Ebor Mills, Haworth (**A2**, Figure 2.11: A87) (Plate 25).

The variety of different locations for the wheelhouse within the Yorkshire textile mill and the evidence suggesting that wheelhouses were spatially distinct from the rest of the mill complex exhibits a greater degree of flexibility in design than is apparent in mills with steam installations, more of which later. This major spatial difference reveals an interesting point about water power in the mill – it was relatively labour un-intensive in comparison with a steam installation. Apart from the opening of sluices, the waterwheel could be left unsupervised and, in comparison with the steam engine there were few safety implications. It did not therefore require regular attention and members of the workforce dedicated to its operation throughout working hours and this is reflected in its spatial disposition within the mill complex as a whole and its relative isolation.

The amount of space occupied by waterwheels and its implications for the use of space elsewhere in the mill was resolved in a number of ways. In many instances, the bay or bays housing the wheel were also used to house staircases. This was the case at Gibson Mill, Wadsworth (**A3**, Figure 3.3: A101), and despite no surviving evidence for early staircases, was probably also the case at Aireworth Mill, Keighley (**A1**, Figure 1.3: A9), and Ebor Mill, Haworth (**A2**, Figure 2.3: A61). By housing these two features in the same area of the mill, the remainder of the working space was not impinged upon.

During the mid-nineteenth century, the use of water power in the textile mill was developed further with the introduction of the water turbine. By the 1860s considerable advances in the design of water turbines led to increasing efficiency and output comparable with even the largest of waterwheels. The added advantage of the water turbine was that it could operate in times of full or partial water supply and could use even low falls of water. Furthermore, the turbine was compact and could easily be installed. It was common, as at Gibson Mill, Wadsworth (**A3**), and Dunkirk Mill, Oxenhope (**A6**), for turbines to replace waterwheels, being installed in original waterwheel pits. In many cases, this meant that the source of power could be increased but without any physical or spatial change to the mill building. Spatially, therefore, the housing of the turbine resulted in the same types of layouts seen in mills with a waterwheel.

5.1.2 STEAM POWER

The earliest application of the steam engine to the textile industry was as part of water management systems for water powered mills. Steam pumping engines were not uncommon in the late eighteenth and early nineteenth centuries and were used to pump water back up to reservoirs and dams at the head of valleys, thus 'recycling' the water in many streams and becks that powered waterwheels (Clark 1999, 288). Before 1800, 81 steam engines were operating within the Yorkshire woollen industry and it is likely that a high proportion of these were early pumping engines (Jenkins 1975, 82-5; 90) such as those recorded at Low Mill, Keighley (**BFO62356**) and John Marshall's first mill in Water Lane, Holbeck (**BFO41529**) (Giles and Goodall 1992, 133). However, as yet, no archaeological evidence for such early steam installations has been found within Yorkshire.

Developments in the rotative steam engine after 1780 provided a fundamental breakthrough in steam powered technology that could be readily applied to powered machinery and processes within the textile industry. The earliest known use of a rotative steam engine in the textile industry was in 1785-6 when a Boulton and Watt engines was installed in one of Robinson's Papplewick Mill's (Hills 1970, 152-8; Tann 1981; Greatrex 1986a; 1986b). The first known installation of a rotative engine in a Yorkshire mill was in 1792 and by 1800 fourteen such engines were in operation within the county.

The earliest rotative engines were adaptations of the beam engine used for pumping water and it was James Pickard, in 1780, who patented the crank method used to transform the vertical motion of the pumping rod to turn a wheel. Early rotative beam engines were generally of small capacity and before 1790 an output of about 10-horse power was common (Tann 1970, 79). Developments to the efficiency of the steam engine, including James Watt's separate condenser led to an increase in output and by the 1830s the average output was about 30-horse power, significantly higher than most contemporary waterwheels. Further developments to the capacity of boilers, the use of high and low pressure cylinders and the use of paired beam engines, as at Saltaire Mills, Saltaire (with a combined output of 1.250 horse power; Plate 26), meant that by the mid to late nineteenth century steam power was able to answer a vastly increased demand for power from a virtually completely mechanised textile industry (Giles and Goodall 1992, 134-5). The increasing size of mills and the machinery that they housed may therefore partly be attributed to the opportunities for greater productive output because of more powerful sources of motive power.

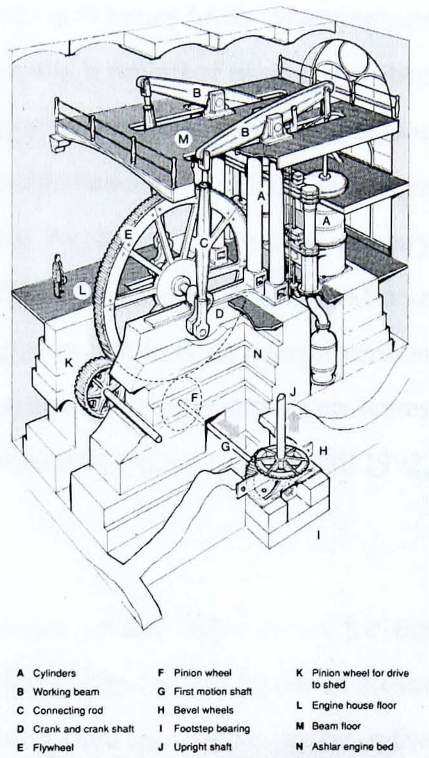

Plate 26 *Reconstructed view of paired beam engines, Saltaire Mills, Saltaire (Giles and Goodall 1992, 154)*

Between 1860 and 1890 the horizontal engine became a preferred source of power within the textile industries. The horizontal engine was not a new invention, but it was not until improvements to its overall design in the mid nineteenth century that it became a viable option in factories (Plate 27). The first recorded use of the

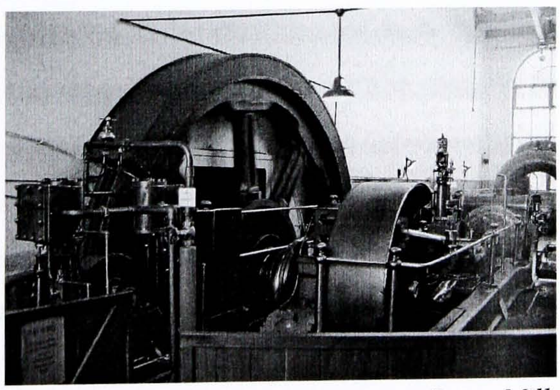

Plate 27 *Horizontal engine, Queen Street Mill, Burnley*

horizontal engine in the Yorkshire textile industry was at Whetley Mills, Manningham (**BFO62440**) in *c.*1864-5. For several decades there was a period of overlap between beam and horizontal engines, but by the 1890s the installation of new beam engines was uncommon. The horizontal engine offered considerable benefits. It offered smoother running and a higher and more efficient output and by the early twentieth century engines such as that at Hare Mill, Stansfield (**BFO62239**), could run at 3,000-horse power. In some instances, the inverted vertical engine (essentially an upright version of the horizontal engine) was preferred, usually where there were considerable pressures on available space, as at Waterloo Mills, Silsden (**BFO62292**) (Giles and Goodall 1992, 135).

The development of the steam engine had two major spatial implications for the Yorkshire textile mill: its location and its physical form. The increasing use of steam power in the textiles industries has traditionally been seen as a major factor in the location of the industry, bringing about the relocation of industry with a marked shift away from river valley locations to growing urban settings from the early nineteenth century onwards (Markus 1993, 264; Clark 1999, 287). However, the archaeological evidence from Yorkshire suggests that not only did waterpower remain a major sources of power at many sites – at Ebor Mill, Haworth (**A2**), where the early mill remained water powered despite the evolution of a sophisticated steam plant at the site from the mid nineteenth century – but that locations close to a source of water remained important for the running of steam power (see Holden 1999). Old Lane Mill, Northowram (**A4**, Figure 4.1: A130), was partly built over the Ovenden Beck, whilst at Britannia Mills, Lockwood, Huddersfield (**A5**, Figure 5.1, A165), built between *c.*1830 and 1860, a site was chosen close to ready supply of water and the location of one of the mills on the banks of the River Colne resembled a typical water powered mill. Similarly, the late nineteenth century Victoria Mills, Elland (**A12**, Figure 12.1: A368), is built on the banks of the Black Brook. All of these mills were built as steam powered factories.

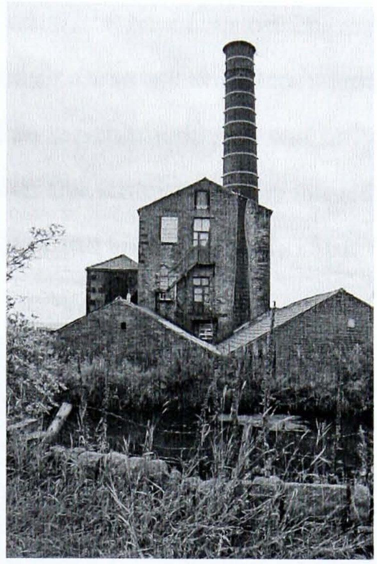

Plate 28 *One of the two reservoirs supplying water to a steam engine at Pecket Well Shed, Wadsworth*

The fact is that although steam power liberated mills from a source of flowing water, it too demanded a supply of water, particularly following the development of condensing engines. This was most easily achieved by adopting a site next to a river or beck and in the case of mills like Dunkirk Mill, Oxenhope (**A6**, Figure 6.1: A207) and Aireworth Mills, Keighley (**A1**, Figure 1.5: A16), which had previously been water powered, the earlier mill ponds and mill races could be adapted to served boilers. At sites where there was no ready supply of water, reservoirs were constructed. At Ardsley Mills, East Ardsley (**A9**, Figure 9.1: A288), a large reservoir was built close to the boiler house, whilst at Pecket Well Shed, Wadsworth, two reservoirs, one acting as a condensing pool, were constructed (**A7**)(Plate 28). The reservoir was a common feature of urban mills, although even within towns the opportunity was taken to build mills close to natural becks, streams, rivers and canals. This evidence invites a revision of the orthodox view that steam power liberated the location of the textile industry. Rather, the steam engine freed the textile industry from the need for a water supply possessing sufficient power to drive a water wheel, but a water supply, natural or artificial, remained an important aspect in the location of mill sites (Holden 1999, 50).

The introduction of steam power was coeval with the development of new types of structure at the textile mill, principally the engine house, boiler house, chimney, and, at some mills, an economiser house. Each of these had implications for the spatial development of a site especially in those instances where a steam installation was being added to an earlier site.

The type of engine house adopted depended largely on the type of steam engine installed. The design of the beam engine meant that the engine was not only dependent on the engine house for shelter but also for the support of its superstructure. It was only with the advent of the horizontal and vertical engines that the structure of the engine house became largely separate from the engine itself (Giles and Goodall 1992, 136).

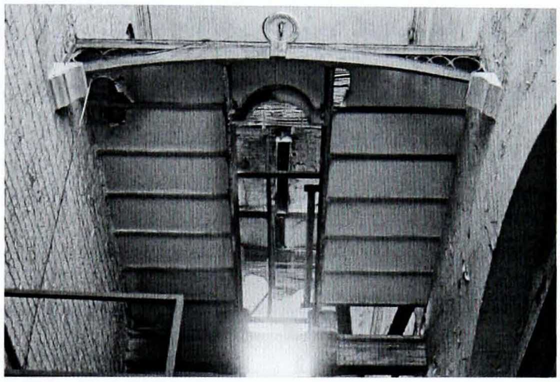

Plate 29 *Surviving beam floor and entablature beam, Old Lane Mill, Northowram*

It was common in the case of beam engine houses for the beam of the engine to be supported at its pivot point on a heavy masonry support or on an entablature beam of cast iron supporting both the beam of the engine and a 'beam floor' permitting maintenance of the upper parts of the engine. Archaeological evidence for beam floors often survives, as at Pecket Well Shed, Wadsworth (**A7**), and Old Lane Mill, Northowram (**A4**)(Plate 29) and as these two examples show, the opportunity was usually taken to add embellishments to the integral ironwork. The reasons for this elaboration will be discussed in greater detail in Chapter Eight; suffice to say here that it is clear that the architectural treatment of the engine house often went beyond the purely functional and practical aspects of the design of the engine house.

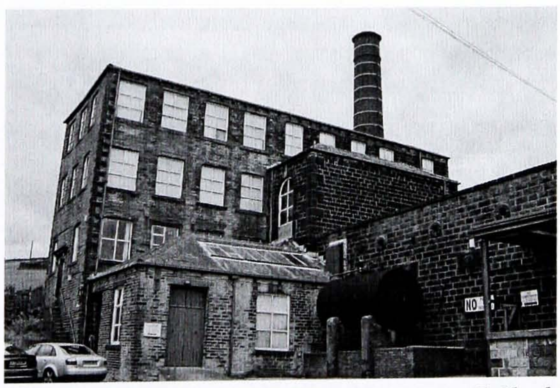

Plate 30 *Beam engine house, Pecket Well Shed, Wadsworth: it is typically tall and narrow and lit by a round-headed window*

The beam engine house was typically a tall, narrow room, resembling the shape of the engine that it housed. As a consequence, it was common for the beam engine house to occupy one bay of a multi-storey mill or the corner of a shed, as at Pecket Well Shed, Wadsworth (**A7**, Figure 7.1: A238) (Plate 30). At Old Lane Mill, Northowram (**A4**, Figure 4.2: A137), the engine house rose through the first three storeys of the mill and at Firth's Mill, Lockwood, Huddersfield (**A5**, Figure 5.3: A172), it rose through two storeys. At Pecket Well Shed, Wadsworth (**A7**, Figure 7.1: A238), the beam engine house was located at the end of weaving shed and a multi-storey warehouse and sizing block. At sites where an increased power supply was required pairs of beam engines were often installed, both powering a single flywheel. In these cases, the engine house was usually broader, such as the three-bay engine houses at Saltaire Mills, Saltaire (**A8**, Figure 8.1: A266).

Horizontal engine houses varied in size and form. Some were tall, lofty structures similar to the engine houses used for beam engines, and most were long, narrow rooms. However, other installations were small. At Gibson Mill, Wadsworth (**A3**, Figure 3.5: A114), the horizontal engine was accommodated within a small, low engine house at one end of the mill, whilst the engine at Victoria Mills, Elland (**A12**, Figure 12.3: A377), was housed within a two-bay extension to the mill (Plate 31). In contrast, at Ardsley Mills, East Ardsley (**A9**, Figure 3: A294), the 1913 cross-compound engine was housed in a wide engine house of two-storeys (Plate 32), typical of a large-scale steam installation, whilst at Frostholme Mill, Todmorden and Walsden (**A10**, Figure 10.3: A322), the engine house was a tall room rising through four storeys and of six-bays in

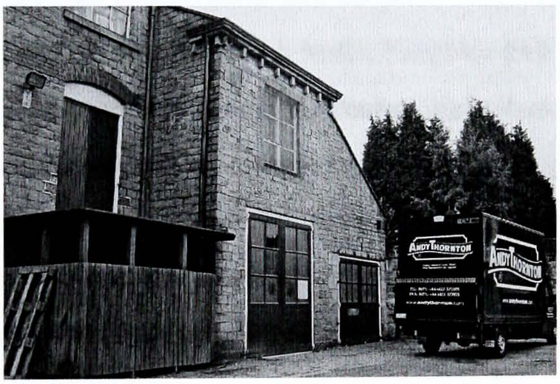

Plate 31 *Horizontal engine house, Victoria Mills, Elland*

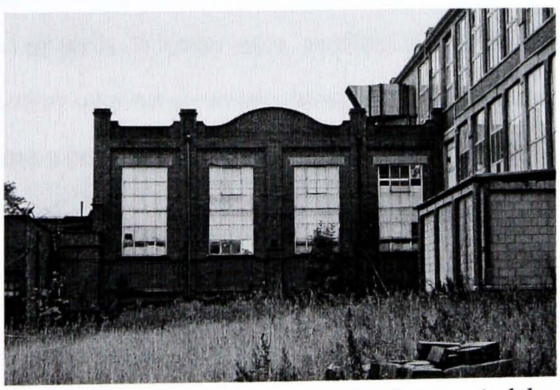

Plate 32 *Large projecting engine house, Ardsley Mills, East Ardsley*

length. In many horizontal engine houses a degree of height was maintained to allow space for an overhead crane, as at Frostholme Mill, Todmorden and Walsden (**A10**), or other lifting devices, like pulley rings in the ceiling of the late engine house at Ebor Mill, Haworth (**A2**), which provided a means of installing the engine and future maintenance. Inverted vertical or marine engines also had a characteristic form, being rather more compact on plan but taller than most horizontal engine houses.

The effect of the engine house on the spatial form of the mill largely reflected the need for efficient power transmission. The positioning of the engine house therefore largely mirrored that of the wheelhouse and there is a degree of continuity between in the housing of these two different types of power source. Like the wheelhouse, the engine house might be positioned in a number of different positions. At Old Lane Mill, Northowram (**A4**, Figure 4.2: A137), and Britannia Mills, Lockwood, Huddersfield (**A5**, Figure 5.3: A172; Figure 5.4: A177), an internal end position was adopted, whilst at Victoria Mills, Elland (**A12**, Figure 12.3: A377), and Aireworth Mills, Keighley (**A1**, Figure 1.5: A16), an attached end engine house was favoured. At Pecket Well Shed, Wadsworth (**A7**, Figure 7.1: A238), an attached side engine house powered the weaving shed, whilst at Frostholme Mill, Todmorden and Walsden (**A10**, Figure 10.3: A322), an internal central position was adopted. In contrast, Ardsley Mills, East Ardsley (**A9**, Figure 9.3: A294), was built with an attached central engine house.

However, unlike the wheelhouse, existing buildings at the site might also dictate the position of the engine house. The organic growth of many sites, particularly from the early nineteenth century when steam power replaced water power at many sites, favoured some positions for the engine house over others. For instance, the attached end engine house at Dunkirk Mill, Oxenhope was easily built at the west end of the water powered mill and the new source of power integrated with the existing system of power transmission (Plate 33). However, at some sites the transition between water and steam power was not so easy. At Aireworth Mills, Keighley, and Gibson Mill, Wadsworth (Plate 34), existing structures and the natural topography of the site necessitated the construction of engine houses at the opposite end of the mill to the earlier waterwheel. In both cases this would have meant considerable alteration to the existing means of power transmission, and it seems that at both of these sites steam power was, at least for a time, used as an auxiliary source of power for select parts of the complex, whilst the waterwheel continued to power the main part of the mill.

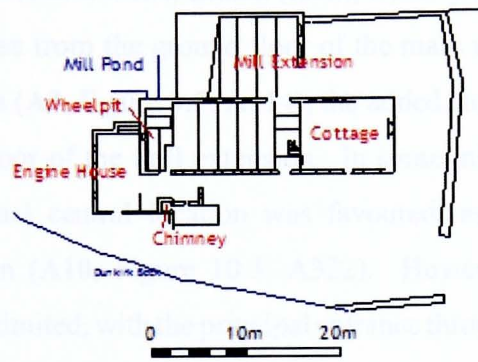

Plate 33 *At Dunkirk Mill, Oxenhope, the later engine house was built immediately west of the earlier wheelpit*

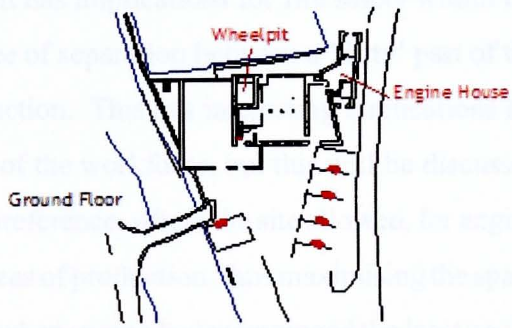

Plate 34 *Restricted space at Gibson Mill, Wadsworth, meant that the later engine house was located inconveniently at one corner of the mill*

Regardless of their physical position the engine house was usually spatially distinct from the rest of the mill. Gamma maps of a of from Yorkshire sites reveal a relatively consistent spatial pattern. The engine house, like the wheelchamber, is represented by a single space, usually accessed directly only from the mill yard or other external space, as at Firth's Mill, Britannia Mills, Lockwood, Huddersfield (**A5**, Figure 5.9: A196) (Plate 35). In a few instances some means of

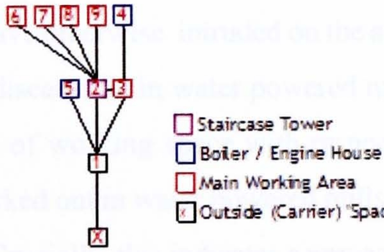

Plate 35 *In spatial terms, engine houses were typically distinct from the rest of the site as at Firths Mill, Huddersfield*

internal communication was provided. At Victoria Mills, Elland (**A12**), a heavy iron door separates the attached end engine house from the ground floor of the main mill building, whilst at Gibson Mill, Wadsworth (**A3**, Figure 3.5: A114), the added steam plant is accessible only from the ground floor of the mill extension. In some mills, restrictions on space meant that an internal central location was favoured, as at Frostholme Mill, Todmorden and Walsden (**A10**, Figure 10.3: A322). However, communication with the rest of the mill was limited, with the principal entrance through the boiler house and a further, subsidary entrance from the main staircase.

There are a number of functional reasons for this separation of the engine house from the remainder of the mill complex. First, it has implications for fire safety within the mill complex. Second, it enforced a degree of separation between a 'dirty' part of the mill and the 'cleaner' areas used for production. This has interesting implications for labour relations between different sectors of the workforce, but this will be discussed further in Chapter Six. Third, there was a preference, where the site allowed, for engine houses to be located away from the main areas of production, thus maximising the space available for machinery. Naturally, the attached engine house impinged the least on the available working space, but where an internal engine house was used it was usual for it to occupy a distinct part of the mill, for instance two bays across three storeys, and in some cases, the same area of the mill was used to house a stair tower, toilets or small offices, as at Saltaire Mills, Saltaire (**A8**, Figure 8.1: A266), thus putting together a number of key features of the mill that would have otherwise intruded on the available working space. This echoes a spatial pattern discernible in water powered mills and indicates the extent to which the organisation of working space with respect to the generation of power, had been successfully worked out in water powered mills and the same layout adapted for steam powered sites. Crucially, this indicates a preoccupation with the design of working space in the mill, and this has implications for our understanding of the extent to which the textile mill, as a building type, developed in response to the needs of machinery and the workforce required to operate them. This may be interpreted as having both a functional and a social logic and those social aspects will be returned to in Chapter Six.

Key to the steam installation was the boiler house, which, like the engine house, resulted in the need for a new type of building at the textile factory that was unknown of during the age of water power. The earliest boilers installed as textile mills were basic 'haystack' or wagon' types. Haystack boilers, iron or cooper cylinders with a domed top, were largely external structures mounted on a simple brick casing; many continued in use until the mid nineteenth century but they operated at a low pressure and were therefore soon unsuited to the demands of increasingly powerful steam engines. The wagon boiler, often associated with James Watt, was either rectangular on plan with square or 'egg-shaped' ends, and was generally housed within a boiler house. They could operate at higher pressures than haystack boilers and therefore found increased use in the textile mill in the early nineteenth century.

The development of Cornish, Lancashire and Yorkshire boilers resulted from an increased demand for boilers capable of operating at higher pressures and economy in fuel consumption (Giles and Goodall 1992, 146). Probably the most common of these to be installed in Yorkshire mills was, ironically, the Lancashire boiler, patented by Fairbairn and Hetherington in 1844. This design had two internal flues, each with its own furnace and could therefore operate at high pressures and more efficiently than other types of boiler. Where greater power was required a number of boilers could be grouped together. At Saltaire Mills, Saltaire (**A8**), for instance, the original 1850s boiler house contained ten Lancashire boilers (Fairbairn 1863, 264), whilst the vast complex of Manningham Mills, Manningham (**BFO62439**), Bradford had no less than thirty-two boilers in a number of locations across the site (Giles and Goodall 1992, 147).

The boiler house had no specific structural requirements, but its position within the complex was determined by a number of factors. First, proximity to the steam engine minimised loss of steam heat. At Victoria Mills, Elland (**A12**, Figure 12.3: A377), the boiler and engine houses occupied a combined structure attached to the end of the main mill building (Plate 36), whilst at Pecket Well Shed, Wadsworth (**A7**, Figure 7.1: A238), the boiler was located underneath and to one side of the engine house. But, the boiler house also needed to be easily accessible for the delivery of large quantities of coal and where there were internal engine houses they precluded placing the boiler houses next to engine houses. At Ebor Mill, Haworth (**A2**, Figure 2.1: A56), the detached boiler house was placed on the opposite side of the mill yard to the engine house that it served (Plate 37), with steam passing through pipes beneath the mill yard, but perfectly placed for incoming deliveries of coal. At Saltaire Mills, Saltaire (**A8**, Figure 8.1: A266), the boiler house was subterranean, with a railway siding above which dropped coal in to automatic coal feeders supplying the boilers.

Plate 36 *At Victoria Mills, Elland, the boiler and engine house shared the same building*

Plate 37 *At Ebor Mill, Haworth, the detached boiler house was located away from the engine house to take advantage of easy access from the mill yard*

The detached boiler house also had a further logic. With the advent of steam power came the increased risk of fire and the detached boiler house therefore offered a means of isolating areas of highest risk from other buildings in the mill complex. Where the topography of a site precluded the construction of a detached boiler house, an attached or

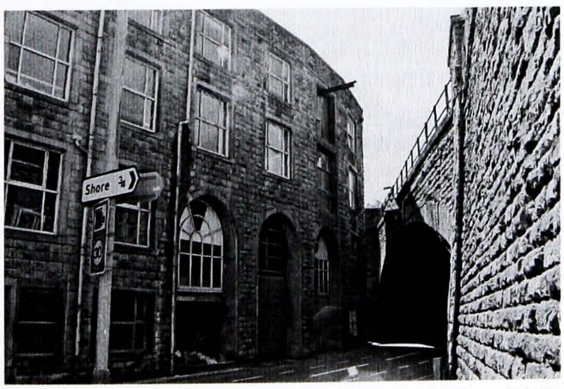

Plate 38 *The boiler house at Frostholme Mill, Cornholme, occupied an internal end position with good access to the road frontage*

internal position was selected. At Frostholme Mill, Todmorden and Walsden (**A10**, Figure 10.3: A322), a large three-bay boiler house rising through two storeys was built in to a multi-storeyed range and with good access to the adjacent main road (Plate 38). Such a location *within* a mill building clearly had implications for the risk of fire and the boiler house is contained within thick masonry walls and sealed by a fireproof brick vault, the only part of the mill to be built of fireproof construction.

Spatially, the boiler house shares many of the characteristics of the engine house. It tends to be an isolated space with access only from the exterior. At a few mills there is some degree of internal communication between the engine and boiler houses, such as at Victoria Mills, Elland (**A12**, Figure 12.5: A386), and Frostholme Mill, Todmorden and Walsden (**A10**, Figure 10.5: 332), but in the majority of cases both structures were spatially isolated, as at Old Lane Mill, Northowram (**A4**, Figure 4.5: A157)(Plate 39). Communication between the engine and boiler men therefore largely relied on the skill of both teams in anticipating demand and supply of steam to keep the mill operational (Conrad Varley [Queen Street Mill, Burnley] *pers. comm.*). As with steam engines and waterwheels it is clear that, in Yorkshire textile mills at least, the boiler house was treated as a part of the mill spatially distinct from the main areas of production.

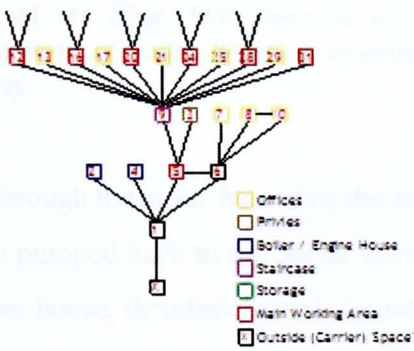

Plate 39 *Spatially boiler houses tended to occupy an isolated part of the mill complex and this excerpt from the system at Old Lane Mill, Northorwram shows*

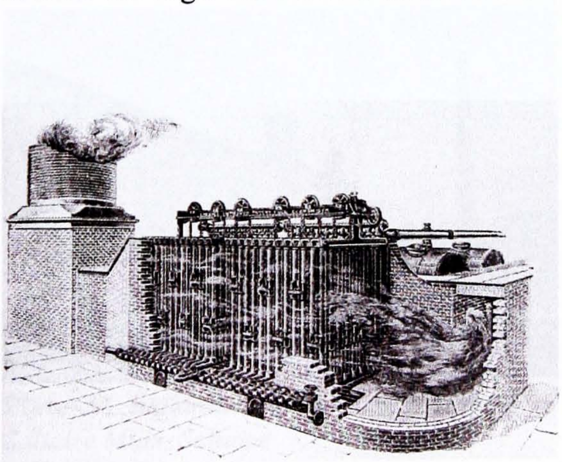

Plate 40 *Green's 'Economiser' (Nasmith and Nasmith 1909, fig114)*

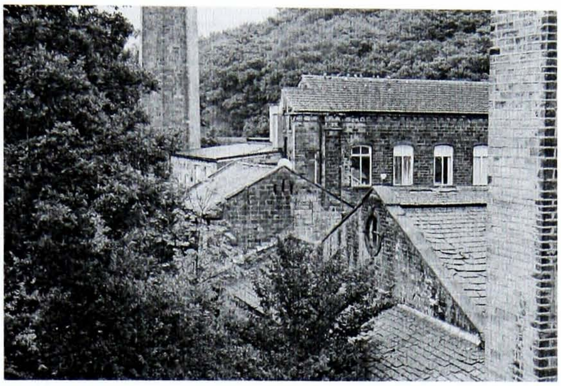

Plate 41 *At Ebor Mill there is a logical arrangement of boiler house, economiser and chimney*

The economiser became a standard part of steam installations from the mid-nineteenth century and provision of economisers to the textile industry was dominated by the company of Edward Green of Wakefield and 'Green's Economiser' (Giles and Goodall 1992, 149; Plate 40). An economiser essentially comprised a series of metal pipes arranged in the flues leading from the boiler to the chimney. Water was pumped through the pipes, heated by the exhaust gases passing through the economiser and then pumped back to the boiler, saving on heating time in the boiler itself. The economiser house, therefore, simply housed this device and was, logically, sited between the boiler house and chimney. Like the boiler house, the economiser house was commonly a detached structure, spatially distinct from the rest of the mill complex and located to one side of the mill yard, away from the principal areas of production. At Ebor Mill, Haworth (**A2**), the boiler house, economiser house and chimney are located in a line along the western edge of the site allowing the logical flow of gases from boiler house to chimney (Plate 41).

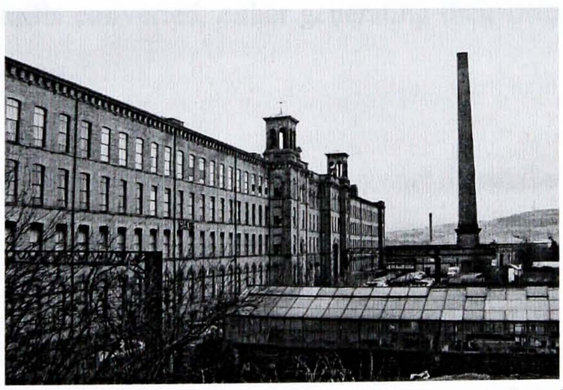

Plate 42 *Italianate chimney to the south of Saltaire Mills, Saltaire*

The mill chimney, though visually dominant, played only a minor role in determining the spatial form of the mill. Naturally, the chimney was usually located close to the boiler house. In early mills, it was common for the chimney to rise from within the boiler house, at as Old Lane Mill, Northowram (**A4**), and archaeological evidence suggests that at smaller, later steam installations where the boilers did not require such a tall chimney, an internal chimney was favoured, as at Dunkirk Mill, Oxenhope (**A6**), and Gibson Mill, Wadsworth (**A3**). However, it was common for later chimneys to be detached and located at the periphery of the site away from the mill yard and principal mill buildings. Thus, at Saltaire Mills, Saltaire (**A8**, Figure 8.1: A266), the vast Italianate chimney was located to the south of the main mill complex, immediately above the subterranean boiler house (Plate 42), whilst at Victoria Mills, Elland (**A12**, Figure 12.1: A368), the chimney was built some distance away from the main mill and beyond the mill yard.

5.1.3 ALTERNATIVE SOURCES OF POWER

From the mid nineteenth century various alternatives to steam power were explored. Gas and oil engines were variously used in Yorkshire textile mills, but never on a large-scale (Giles and Goodall 1992, 163). However, a major breakthrough was the introduction of electric power in the mill, permitted through the use of steam turbines and a linked electric generator, a system patented by Charles Parsons' in 1884 (Dickinson 1938, 194-5). As early as the 1890s such systems were being used to power entire mills in the United States of America (Du Boff 1967, 512) but the adoption of this system in Britain was a rather slow process. The earliest known application of electric power in a Yorkshire mill was Becks Mill, Keighley (**BFO62342**), built in 1907, but after that date an increasing number of mills converted, either generating their own electricity or buying it from a public company.

Where a mill owner chose to generate their electricity, the installation was not dissimilar to a standard steam plant, with boilers, a turbine room and an electric generator. However, the major difference was that electric power in the mill finally eliminated former systems of power transmission that had necessitated a close relationship between the source of power, the means of transmission and the main working areas. At Cheapside Mills, Batley (**BFO63513**), the new turbine house was built at the perimeter of the site, some distance from the buildings it powered. Conversely, at Manningham Mills, Manningham, Bradford (**BFO62439**), the steam turbines were housed in the former engine house thus establishing continuity in the use of certain parts of the site for the generation of power.

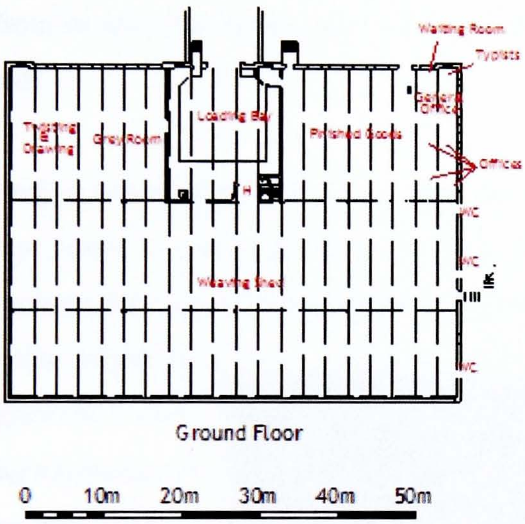

Plate 43 *The use of mains electricity at Park View Mills, North Bierley, liberated the design of the mill from boiler or engine houses and the trappings of traditional power transmission*

Where mill owners chose to purchase electricity from a public company there were no turbine houses, boilers or generators. Indeed, the major spatial change brought about by electric power in the mill is clearest in those mills built for electric power purchased from the national grid. For instance, at Park View Mills, North Bierley (**A11**, Figure 11.2: A343), built 1924-5, there is a marked absence of any power plant resulting in a relatively uncluttered layout with processes and storage areas arranged around a central loading bay (Plate 43). The overall impression is of a modern working environment.

5.2 POWER TRANSMISSION

One of the principal spatial issues to arise out of a consideration of the implications of the source of power on the layout of the mill is the degree of separation between sources of motive power and the main working areas within the mill. It is therefore the means of transmitting power from its source to machinery in the mill that functionally unites these two parts of the mill.

The location of the principal source of power in the textile mill largely dictated the means of transmitting that power to other areas within the mill. Where a site was built with a particular power source and means of transmission in mind, the system of power transmission was usually relatively simple. Where sites grew in a more organic fashion, adopting a sequence of different power sources and, indeed, means of power transmission, the basic system of transmission was often particularly complicated. There are two principal components of power transmission systems: the primary stage, the means of linking the prime mover to the different floors, working areas and buildings within the mill complex; and, the secondary stage, the means by which drive was distributed to machines and processes from the primary system.

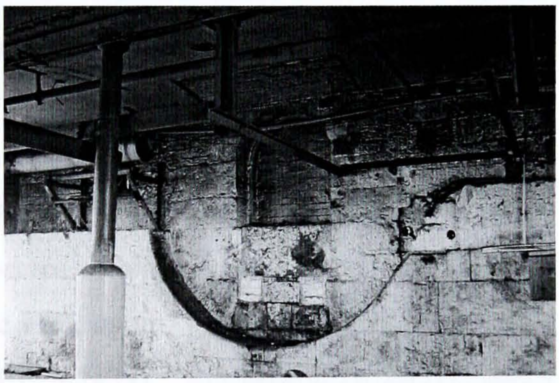

Plate 44 *Recess for vertical gear transmitting power to principal lineshaft at Old Lane Mill, Northowram*

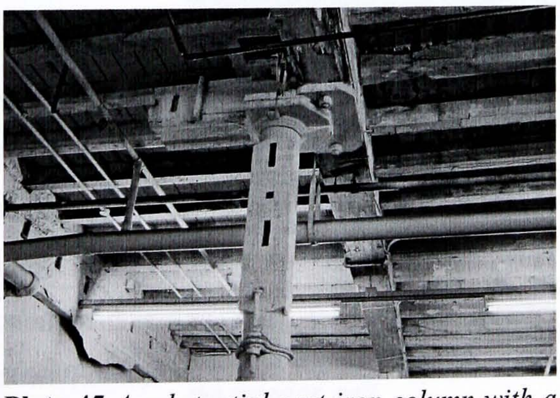

Plate 45 *A substantial cast-iron column with a specialised horizontal bracket supported the principal vertical line shaft in Firths Mill, Huddersfield*

Before *c.*1880, the most common form of primary transmission within mills was the upright shaft. Drive was taken from the prime mover in a number of ways, either directly from the waterwheel or flywheel or by a more indirect means involving an element of gearing, translating the output of the prime mover into higher speeds. At Old Lane Mill, Northowram, (**A4**) (Plate 44), the area of thickened ashlar masonry and circular recesses on the dividing wall between the internal end engine house and the ground floor provides evidence for a gearing system which not only increased the output of the early beam engine but also directed the power horizontally to the corner of the ground floor where it engaged with a vertical shaft. At Firth's Mill, Britannia Mills, Lockwood, Huddersfield (**A5**), a substantial cast-iron column with a principal bracket positioned adjacent to the engine house supported the base of a vertical shaft (Plate 45).

The 'first motion shaft' or principal vertical drive shaft required considerable support. Most often, its base was supported on an ashlar and iron foundation, and shafts were commonly located against an external or internal wall, or alternatively in a corner, to allow support at each floor level by means of cast-iron brackets and plates (Giles and Goodall 1992, 156). In some, later mills, the vertical shaft was located within its own 'tower' rising the height of the mill, as at Whetley Mills, Manningham, Bradford (**BFO62439**), but this system was never common. In single-storey buildings, the same system was used but on a horizontal plane. At Pecket Well Shed, Wadsworth (**A7**), a principal horizontal shaft ran along the inside of the front wall of the shed, supported on iron brackets bolted on to large ashlar blocks; the blocks and bolt holes survive *in situ* (Plate 46). At Queen Street Mill, Burnley, the principal horizontal shaft is located in a similar fashion against the back wall of the shed (Plate 47).

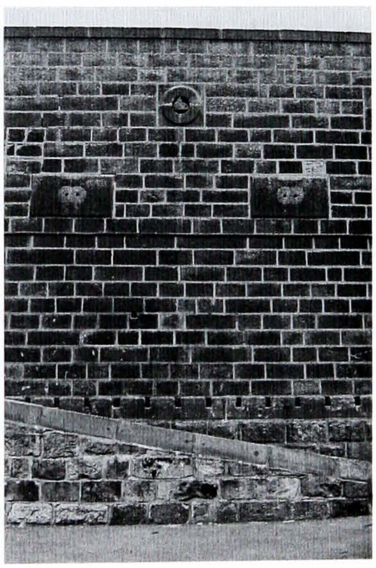

Plate 46 *The main horizontal shaft at Pecket Well Shed, Wadsworth was supported by heavy brackets bolted through the exterior wall*


Plate 47 *Principal horizontal shaft at rear of weaving shed, Queen Street Mill, Burnley*

Upright and horizontal drive shafts connected with the secondary stage in each working area, which usually comprised a smaller line shaft or series of lineshafts, also known as countershafts. The junction between the two shafts was usually contrived through the use of bevel wheels, sometimes geared to raise the speed of the secondary shafts (see Plate 46). In multi-storeyed buildings, secondary shafts usually ran the length of each floor and it was usual for the shaft to be supported by brackets either attached to the columns supporting the structure of the mill or slung beneath beams on cast-iron hangers. D-shaped column heads at Gibson Mill, Wadsworth (**A3**), Britannia Mills, Lockwood, Huddersfield (**A5**), and square-headed column heads at Ebor Mill, Haworth (**A2**), and Victoria Mills, Elland (**A12**), were designed to allow brackets to be bolted to the top of the columns, supporting line shafts running the length of the mill. At some mills, like Ebor Mill, Haworth (**A2**, Figure 2.3: A61), the line of cast-iron columns were placed off-centre allowing the line shaft that they supported to pass down the true centre of the mill along one side of the line of columns. At other mills a more sophisticated system of supporting the smaller line shafts was devised and in some the heads of columns 'split' allowing the shaft to pass straight through the line of structural support. In single-storey sheds, the line shafts tended to be supported on the lines of structural columns; cast-iron hangers from the gutters of the north-lit roof structure were also used to provide intermediate support in sheds.

Power was transmitted from line shafts to machinery by means of leather belts passing over small drums on the line shafts. Drive could be disengaged by clutch wheels and disengaging gear on individual shafts or by passing the belt on to a 'floating' drum which was not attached the line shaft and therefore did not rotate, allowing individual machines to be isolated from the main drive (Plate 48). The ability to be able to isolate individual machines or entire is a particularly important consideration. Of course, it was possible to stop the steam engine, but in most cases it was undesirable to stop and start the source of motive power, which put increased tension on the drive system. It was therefore easier to disengage the drive system to stop individual or groups of machines. These issues are particularly important in the case of room-and-power mills where individual companies renting space in different areas of the mill used a single power source. Thus, at Britannia Mill, Britannia Mills, Lockwood, Huddersfield (**A5**), built in 1863 as a room-and-power, each secondary line shaft leading from the main vertical drive shaft must have had a clutch or disengaging mechanism.

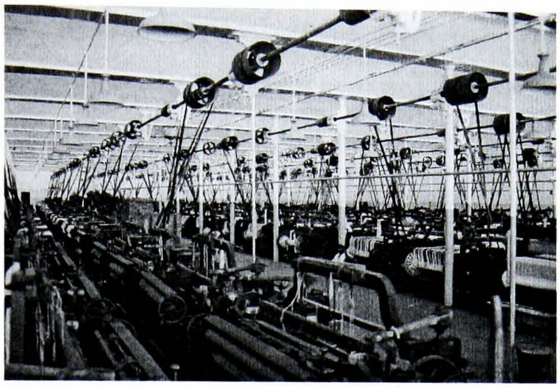

Plate 48 *Pairs of fixed and 'floating' drums on lineshafts, Queen Street Mill, Burnley, enabling individual machines to be turned off*

During the last quarter of the nineteenth century a new form of primary transmission was introduced. Rope drive, made possible by the development of durable cotton rope in the mid 1870s, worked by connecting the engine flywheel with the pulley wheels on the ends of line shafts in multi-storeyed buildings and of countershafts in sheds. In practice, the engine flywheel or rope drum was grooved to take a large number of ropes which were grouped to lead to grooved pulley wheels located at the end of countershafts in different areas of the mill complex. Gearing was achieved through the difference in size between

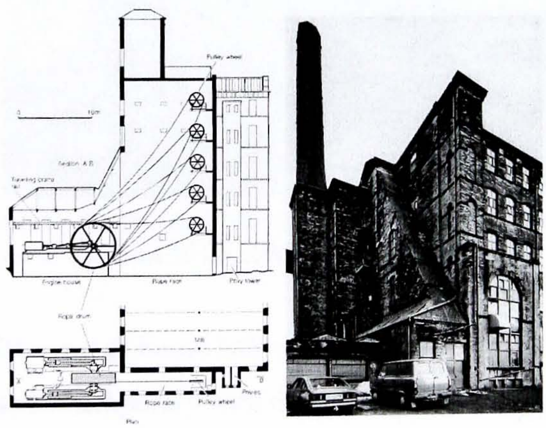

Plate 49 *Example of rope race transmission (Giles and Goodall 1992, 161)*

the rope drum and the pulley wheels (Giles and Goodall 1992, 160-1; Plate 49). The rope drive system had considerable advantages over line shafting as it was simpler to operate and the disruption caused by a broken rope was significantly less than a broken vertical shaft. It transmitted power from the engine in a more efficient manner and it was quieter and safer as there was it eliminated the need for a vertical shaft rising through working areas.

The introduction of rope drive resulted in the development of the rope race, in the case of multi-storeyed mills, and the rope alley in sheds. In the rope race, the rope drum was usually set at a distance from the pulley wheels to allow a 45-degree or less angle between the drum and the highest pulley. This favoured a projecting external engine house, such as that at Ardsley Mills, East Ardsley (**A9**). Rope alleys were usually situated along one side of a shed with the rope drum in a central position.

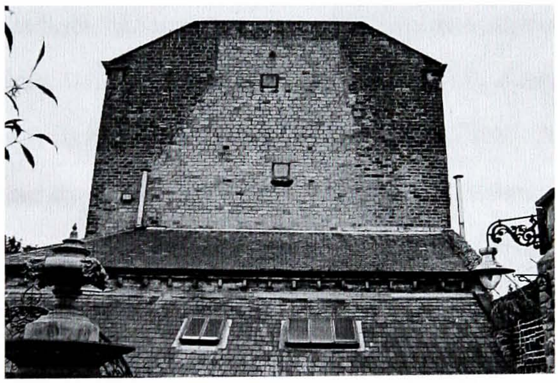

Plate 50 *Evidence for an external timber rope race, Victoria Mills, Elland*

Rope drive systems did not usually affect the spatial form of the mill and like earlier line shafting systems, are best considered as trans-spatial. Many rope races were built along the end wall of multi-storeyed mills and some were housed in insubstantial structures. The external end rope race at Victoria Mills, Elland (**A12**), was a timber-framed structure rising out of the roof structure of the engine house below (Plate 50). Although the external rope race at Victoria Mills was contemporary with the mill it powered, the external rope race could be built against existing structures as at Barkerend Mills, Bradford (**BFO62549**), allowing a new system of power transmission to be added without significant alteration to the internal layout of the mill. In other cases, the rope race was placed in the centre of the mill and thus divided the mill into two halves. This was the case at Ardsley Mills, East Ardsley (**A9**, Figure 9.3: A294). Here, as was common at other sites in Yorkshire, the rope race was built at one end of the multi-storeyed mill in anticipation of expansion, whereby the mill was doubled in size on the opposite of the rope race, thus putting the rope race in a central position (Plate 51). The rope race was therefore a flexible system of primary power transmission that could easily be altered or added to in a much simpler way than was possible with earlier systems.

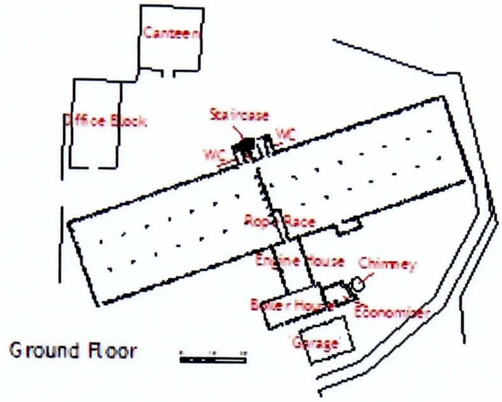

Plate 51 *The rope race at Ardsley Mills, East Ardsley occupied a central position and defined the two halves of the mill*

However, although it might be centrally located the rope race did not play a major role in the spatial configuration of the mill as a whole. At many sites it was only accessible from the engine house via a system of ladders, whilst at others, like Ardsley Mills, East Ardsley (**A12**), the pulleys within the rope race could be accessed from each floor. It therefore fulfilled a basic function – to house the primary means of power transmission and to supply power to the areas where it was required in the most efficient manner possible. Unlike the traditional vertical shaft, rope drive did not physically pass through other spaces in the mill, but was nonetheless trans-spatial because it was designed to pass by other spaces without compromising or altering the available working space. Thus the external rope race completely removed the rope drive from the mill, whilst it was common for internal rope races to occupy a bay of the mill building along with privies, stair towers and overlookers' offices, as at Ardsley Mills, East Ardsley (**A12**).

The advent of electric power in the mill largely liberated the form of the mill from the requirements of power transmission. At many existing sites electricity was introduced through the group drive, where by large motors powered countershafts. This system therefore represented something of a hybrid between the new source of power and traditional methods of line shafting. At Saltaire Mills, Saltaire (**A8**), the group drive motors were placed at the extreme ends of each working area and set high above the heads of workers on steel frames to reduce the amount of space they occupied (Plate 52), whilst a more common arrangement was to place motors on substantial iron or steel brackets at the ends of the countershafts, such as that which survive in the East Shed, Frostholme Mill, Todmorden and Walsden (**A10**) (Plate 53). Over time, the use of individual motors attached to each machine was adopted, eliminating the need for line shaft altogether.

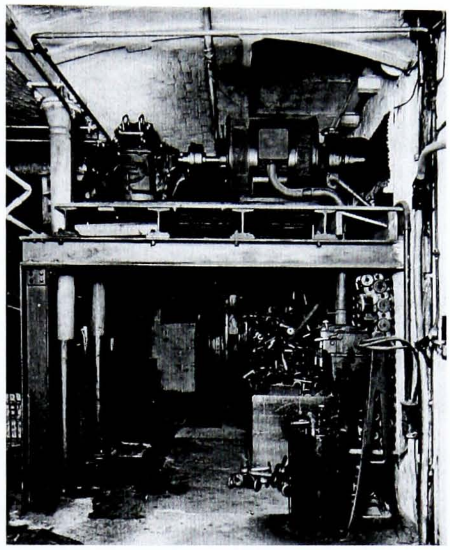

Plate 52 *Group drive motor, Saltaire Mills, Saltaire (Giles and Goodall 1992, 164)*

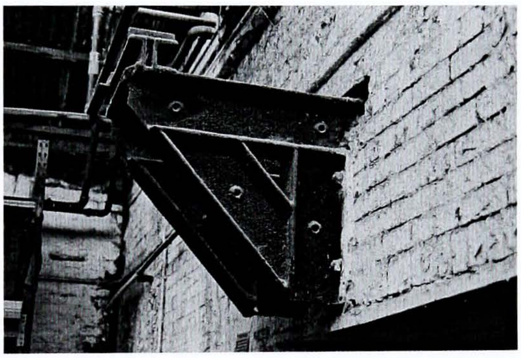

Plate 53 *Steel bracket to support an electric motor, Frostholme Mill, Cornholme*

However, the impact of the 'electric revolution' on the spatial form of the textile mill is clearest at those sites built to run entirely on electric power. Park View Mills, North Bierley (**A11**, Figure 11.2: A343), built 1924-5, is a single-storey shed powered by electricity purchased from a public company. The most notable feature of the shed is the complete absence of any provision for either a central power source or a system of power transmission. In comparison with

Plate 54 *The superstructure of Park View Mills, North Bierley was not designed to support a system of power transmission as the site was built to be electric powered*

earlier mills, the form of the mill is uncluttered and the internal steel frame simple. Nowhere does the superstructure perform anything other than a purely structural function – there is a notable absence of brackets to support line shafts or motors and provision for a source of motive power (Plate 54).

5.3 MACHINERY AND PROCESSES

The subject of the relationship between machinery, processes and the physical form of the mill is a vast subject and much of the surviving evidence is historical in nature. The following discussion of the ways in which the physical form of the mill reflected the machinery and processes that it housed will therefore concentrate on a few salient areas and explore most closely those aspects most for which archaeological evidence survives.

The first generation of mills were multi-storeyed structures and rectangular on plan and it has been argued more often than not that this form was adopted because it reflected the requirements and the size of early textile machinery. Chapman (1981-2) (see also Tann (1973) argued that there was a close relationship between early technological innovations and the form of the earliest mills. He pointed to the evidence for the 'Arkwright-type' mill - roughly 22m x 9m and three or four storeys high and suggested that there was an inseparable relationship between the patents for Richard Arkwright's early machinery and the mills in which they were housed. Thus, during the period of Arkwright's patents, 1771-1785, Arkwright sold licences for units of a thousand spindles at a time and this resulted in the spread of 'Arkwright-type' mills of similar form and dimension.

However, Giles and Goodall (1992, 26) have pointed out that although the widths of early textile mills in Yorkshire largely reflect the typical width of the 'Arkwright-type' mills, their lengths and heights do not. Thus, Gibson Mill, Wadsworth (**A3**, Figure 3.3: A101), built *c.*1800, measures 11 metres wide, but only 12 metres long, whilst Aireworth Mills, Keighley (**A1**, Figure 1.3: A9), rebuilt in 1808, was 9 metres wide but over 30 metres long. The degree we can attribute the apparently 'standard' width of early mills to Arkwright's patents is questionable particularly since the number of patents and licences sold by Arkwright is far less than the number of early mills of similar dimensions. However, two factors seem important. First, the form of the Arkwright type mill was undoubtedly influential and it is not inconceivable that mill builders erected mills in that style but to house other machinery that was outside of Arkwright's patents. Second, the width of early mills seems to reflect the types of machinery available. The late eighteenth and early nineteenth centuries were a period of considerable technological innovation, but there is an appreciable similarity in the sizes of machinery. This partly reflects the fact that many new inventions were simply improvements to existing machines, but it also reflects limitations in materials and power sources which, initially at least, restricted the size of machines.

Plate 55 *Typical arrangement of spinning mules along the length of a multi-stroyed mill at Quarry Bank Mill, Wilmslow*

The width of the earliest mills suited the housing of two rows of machinery down the length of the mill, and the increasing size of machinery during the industrial revolution was largely mirrored by an increase in the length of Yorkshire textile mills. Remarkably consistent during the industrial revolution was the practice of arranging machines in multi-storeyed buildings in long rows along the length of the building (Plate 55). From the late eighteenth century the spinning mule was widely adopted as the principal piece of spinning machinery. The length of mules could vary considerably from several hundred to several thousand spindles and improvements to allow longer machines and a self-acting motion were forthcoming during the early and mid-nineteenth century. However, the space required for the operation of the mule, that is the action of the drawing out of the thread and its attenuation varied little. Thus the size of the 'mule gate', the area travelled by the mule carriage during operation, varied little and as mules were arranged laterally along the length of mills this would explain the greater variation in the length of mills during the industrial revolution and rather than changes to their width. In fact that archaeological evidence from Yorkshire suggests that the maximum internal span of mills (either between walls and columns or rows of columns) only increased slightly across 150 years of mill building (Table Four):

TABLE FOUR: *MAXIMUM SPANS BETWEEN STRUCTURAL ELEMENTS, YORKSHIRE TEXTILE MILLS c. 1770-1930*

SITE	PERIOD WHEN BUILT	MAXIMUM SPAN (M)
Aireworth Mills, Keighley (**A1**)	EARLY	4.9
Ebor Mill, Haworth (**A2**)	EARLY	4.8
Gibson Mill, Wadsworth (**A3**)	EARLY	5.6
Old Lane Mill, Northowram (**A4**)	EARLY	4.8
Firth's Mill, Lockwood (**A5**)	MIDDLE	6.4
Britannia Mills, Lockwood (**A5**)	MIDDLE	6.2
Dunkirk Mill, Oxenhope (**A6**)	MIDDLE	7.2
Pecket Well Shed, Wadsworth (**A7**)	MIDDLE	3.1
Saltaire Mills, Saltaire (**A8**)	MIDDLE	11.5
Ardsley Mills, East Ardsley (**A9**)	LATE	7.1
Frostholme Mill, Todmorden and Walsden (**A10**)	LATE	7.3
Park View Mills, North Bierley (**A11**)	LATE	14.4
Victoria Mills, Elland (**A12**)	LATE	6.4

The remarkable continuity in the maximum span between structural elements in the textile mill (walls and columns) and therefore in the amount of space available between structural elements of the multi-storeyed building goes some way towards explaining the longevity of mill buildings despite continued innovation in textile machinery, particularly in the late nineteenth and early twentieth centuries. Testament to this flexibility is the fact that Victoria Mills, Elland (**A12**), rebuilt in 1898, and Ardsley Mills, East Ardsley (**A9**), built in 1912, remained in use for textile production, using the latest machinery until the 1980s. Furthermore, Globe Mills, Slaithwaite (**BFO62992**), built between 1887 and 1889, continues to be the home of the Globe Worsted Company Ltd., superfine spinners and combers of wools for the textile trade (Sutcliffe *pers. comm.*).

Like the multi-storey mill, the single-storey shed also offered considerable flexibility in the available working space. Interestingly, there is a greater variation in spans between structural columns in the shed, ranging from closely set columns at a distance of 3 metres at Pecket Well Shed, Wadsworth (**A7**, Figure 7.3: A243) (1858), to a maximum span of over 14 metres at Park View Mills, North Bierley (**A11**, Figure 11.2: A343) (1924-5). However, this variation cannot be entirely the product of advances in structural engineering, notably the development of the steel frame, for the span between the columns in the weaving shed at Saltaire Mills, (**A8**), built *c.*1853, is over 11 metres apart and yet the structure of the shed is built along the same principle as the shed at Pecket Well Shed, Wadsworth (**A7**).

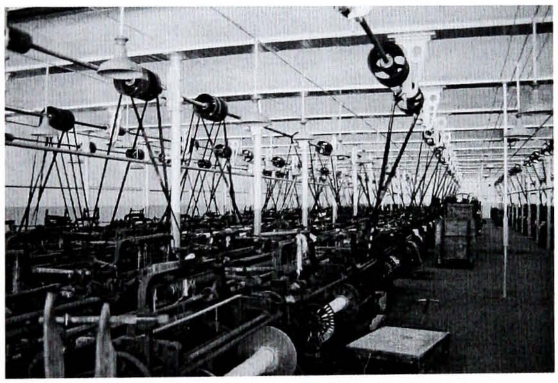
Plate 56 *Rows of densely packed powerlooms in the weaving shed, Queen Street Mill, Burnley*

The variation in spans between columns largely reflects the flexibility of housing powerlooms for which most sheds were built. Unlike spinning machinery, the loom was a compact machine and the greatest variation was in height: Jacquard and 'Dobby' looms were significantly higher machines because of overhead components allowing complicated designs to be woven in comparison with the squat Lancashire loom. Furthermore, the loom did not, unlike machines like the mule, for instance, increase in size during operation and only required an amount of space equal to its footprint. Looms could therefore be closely arranged in rows back-to back, and with narrow walkways within which the weavers would stand operating supervising up to 8 looms depending on the design being woven and the thickness of thread used (thinner thread could be held in the shuttle while coarse threads required more changes of reels than finer cloths) (Plate 56). This raises an interesting issue about the increasing popularity of the single-storey shed from the late nineteenth century in preference to the multi-storeyed mill. Closely set columns in sheds usually prohibited the housing of processes like mule spinning, but as spinning machinery developed (with fewer moving external parts) and as structural developments such as steel framing allowed increasing spans in sheds many of the processes at the textile mill moved into single-storey sheds.

Within the Yorkshire textile mill there was, naturally, a degree of separation between different processes and the most obvious distinctions are seen at integrated sites. The development of the integrated textile mill after the second quarter of the nineteenth century (Giles and Goodall 1992, 85) was in itself a major spatial change and effectively brought about the end of outworking in many areas of the textile industry. At integrated sites, the preparatory, spinning, weaving, finishing processes were brought together at a single-complex

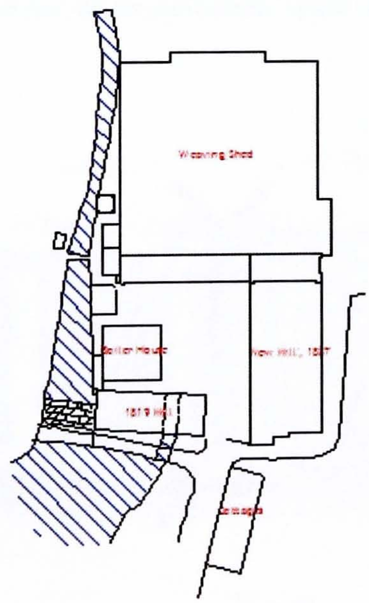

Plate 57 *Processes at Ebor Mill, Haworth, were arranged around a mill yard*

and in many cases dyeworks and administrative blocks, such as offices were also built at the mill site. The variety of processes at the site naturally reflected the sector of the industry to which the mill belonged and integrated worsted mills, for instance, are distinguished by the presence of a combing and weaving shed, as at Saltaire Mills, Saltaire (**A8**, Figure 8.1: A266). Given the number of different processes at integrated site and the presence of a number large number of workers with different skills, it is not surprising to find that specific parts of the mill was designated for different parts of the production process. However, it was common for many 'specialist' mills to also house a number of different processes; it was, for instance, common for spinning mills also to accommodate the preparatory stages of production.

The distribution of processes within individual buildings and across entire sites varied considerably although, as a general rule, spinning was undertaken in multi-storeyed buildings and weaving in sheds. Other processes were variously accommodated in either form of building. At Ebor Mill, Haworth (**A2**, Figure 2.1: A56), as at so many other sites, the arrangement of the mill around a central courtyard was especially suited to the principles of flow production and acted as an intermediate space between processes (Plate 57).

Although little evidence survives at many sites to indicate how processes were housed throughout the complex, the fortunate survival of some documentary sources allows something of the layout of the production to be reconstructed. At Saltaire Mills, Saltaire (**A8**), the surviving layout and a vast archive allows the production to mapped onto the mill – with sorting and preparatory processes undertaken down

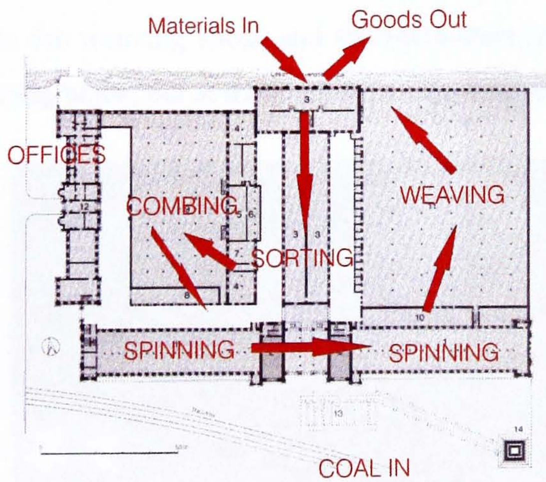

Plate 58 *Processes at Saltaire Mills, Saltaire, were arranged in a circular pattern around the site*

the spine of the complex, spinning in the main range facing the railway and weaving in the shed behind. Raw materials arrived in the main by the canal and could therefore be moved directly to the preparatory areas, whilst finished goods in the weaving shed could easily be moved to the covered wharf. There is, then, a roughly circular pattern to the layout of processes at the site (Plate 58).

At smaller, more specialist sites, such lateral demarcation of space was substituted for a vertical division of working space. At Victoria Mills, Elland (**A12**) and within living memory, the ground floor was used for preparatory processes such as slubbing and carding, the first floor for spinning, the second floor for winding and twisting and the top floor for storage prior.

At Ardsley Mills, East Ardsley (**A9**), the vertical division of the late twentieth century layout of the mill was less clear, with spinning in the eastern half of ground floor whist the other half was used for storage. The first floor was used for drawing, spinning and warping, and the top floor for spinning and twisting. At many weaving mills, processes other than weaving but essential to the process were usually housed in multi-storeyed blocks whilst the looms occupied large sheds. This was the case at Frostholme Mill, Todmorden and Walsden (**A10**), and Pecket Well Shed, Wadsworth (**A7**). At the former there was good communication between the weaving sheds and the multi-storeyed warehouse and taping, winding and beaming block, but at the latter the multi-storeyed sizing block was largely separate from the weaving shed.

Plate 59 *Attic space at Old Lane Mill, Northowram*

The attic storeys of most mills were used for production or storage and it was usual for queen post trusses, such as those at the 1819 mill at Ebor Mill, Haworth (**A2**), to be used to provide an open and full height working space. At other mills, trusses were raised on cast-iron feet to increase the available head-height, with surviving in the mid-nineteenth century Firth's Mill, Lockwood, Huddersfield (**A5**), and the 1887 mill at Ebor Mill, Haworth (**A2**). At other sites, considerable effort was made to engineer trusses affording working space in the attic. At Old Lane Mill, Northowram (**A4**), the soffit of the trusses formed a arch-shape, remarkable similar to an illustration in Baines (1835) showing mules in an attic with the mule gates extending into the tallest part of the attic space (Plates 59 and 60). At Saltaire Mills, Saltaire (**A8**), the light-weight roof trusses allowed a low-pitch but maximum head height. In addition, most attic storeys were top-lit. The 'New Mill' at Ebor Mill, Haworth (**A2**), a north-lit roof was employed (Plate 61), whilst at other sites sky-lights were used, as at Saltaire Mills, Saltaire. Consequently, most attic spaces were well lit and it was common for them to be used for finishing processes.

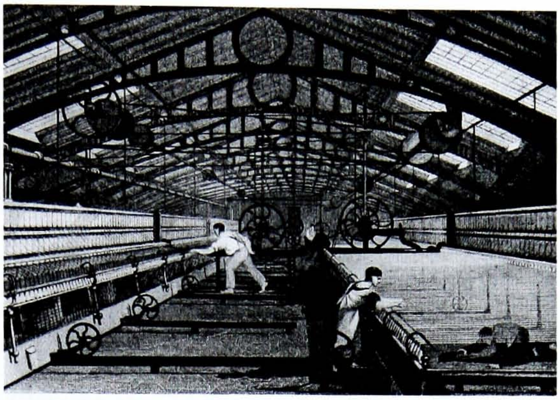

Plate 60 *Illustration from Baines (1835) showing an attic similar to that at Old Lane Mill, Northowram (Plate 58) used for spinning*

Plate 61 *North-lit top storey, 'New Mill, Ebor Mill, Haworth*

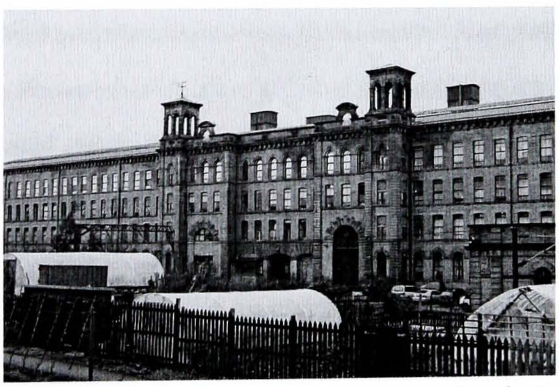

Plate 62 *Privies were accommodated in projecting towers at Saltaire Mills, Saltaire*

A major consideration in the design of the mill was the maximum amount of working space and the demand for larger work spaces within the mill had a profound effect on the spatial form of the mill. From the mid nineteenth century it was common for staircases, privies and small offices to be housed in towers on the outside of multi-storey mills and, in the case of sheds, for overlookers' offices and privies to be housed outside the shed in projecting structures. This was the case at Saltaire Mills, Saltaire (**A8**) (1853; Plate 62) whilst at Ardsley Mills, East Ardsley (**A9**, Figure 9.3: A294)(built 1912; Plate 63), all services, including privies, office, a hoist and the main staircase were accommodated in the staircase tower leaving the maximum amount of uninterrupted working space. At Pecket Well Shed, Wadsworth (**A7**, Figure 7.3: A243)(1858), toilets and the overlookers' offices and privies were located outside the shed even though it meant excavating and terracing the hillside behind the mill. The increasing popularity of the stair tower is most noticeable at earlier mills where a stair tower was added. At Aireworth Mills, Keighley (**A1**, Figure 1.5: A16), rebuilt in 1808, a Gothicised tower was added to the earlier mill, allowing the internal staircases to be removed and thus increasing the available working space, whilst at the 1819 mill at Ebor Mill, Haworth (**A2**, Figure 2.2: A60), a single-bay extension containing a staircase had a similar effect. The use of the external tower for staircases and privies also had important social and architectural implications, which will be discussed in greater detail in Chapters Six and Seven. However, and in the context of the current discussion, the tendency to house elements of the mill, such as services and stairs in projecting structures, may be seen as a centripetal force acting on mill design in which there was a progressive movement of certain features of the mill to the outer edges of individual structures allowing greater areas of uninterrupted working space. This centrifugal action, as it will become clear in the following chapter, is crucial to our understanding of the interplay of practical and social factors on the physical form of the mill.

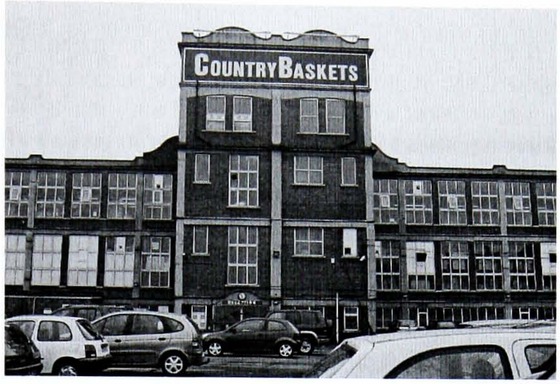

Plate 63 *The tower at Ardsley Mills, East Ardsley housed privies, offices, a hoist and the main staircase for the mill*

5.4 MOVEMENT OF MATERIALS AND GOODS

From the late eighteenth century to the early twentieth century, increased attention was paid to the movement of goods and materials around the Yorkshire textile mill complex. At specialist and integrated sites the mill yard remained a consistent feature and played a major role in the movement of goods and finished materials in, out and around the mill site.

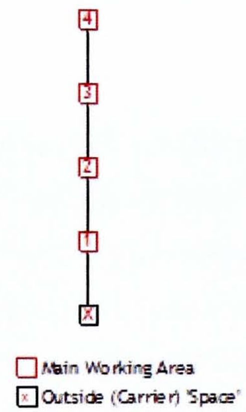

Plate 64 *Gamma map of the movement of materials/goods, Gibson Mill, Wadsworth, c.1800*

Inside the earliest mills, the movement of materials and goods was evidently a labour intensive job. There is little or no evidence at early mills for taking-in doors, external hoists or any provision for windows being used as a means of moving materials and goods to and from the mill. During this research no evidence was found for internal trap doors, though at sites with timber floors early trap doors may have been removed during subsequent re-flooring. However, the evidence from early mills, such as Old Lane Mill, Northowram (**A4**), that brick arch and flag stone floors suggests no provision of internal trap doors and this may have been common. This evidence suggests that in the first generation of mills goods were moved manually about the mill, presumably carried manually up and down internal staircases.

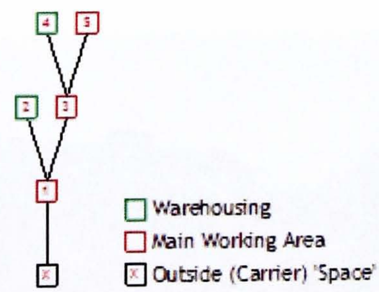

Plate 65 *Gamma map of the movement of materials/goods, Aireworth Mills, Keighley, c.1808*

When the movement of goods in early Yorkshire mills is plotted as a gamma map, a largely linear pattern emerges, whereby access to successive working areas in the mill is via another space.

For instance, the gamma map of the movement of materials and goods for the earliest phase at Gibson Mill, Wadsworth (**A3**, Figure 3.6: A117), built c.1800, reveals a wholly linear configuration with goods can only be moved to successive floors of the mill after passing through the floor or floors below (Plate 64). At Aireworth Mills (**A1**, Figure 1.8: A33), Keighley, and Old Lane Mill, Northowram (**A4**, Figure 4.4: A152), the potential movement of goods and materials results in a rather more tree-like structure, but upon closer examination it is clear that the main route for goods is still largely linear, involving movement through successive spaces within the mill complex (Plate 65).

The fact that this largely linear process is common in many early Yorkshire mills raises an important issue about the development of the mill as a building type. It is clear that even at the most experimental of sites like Old Lane Mill, Northowram (**A4**), attention to the movement of raw materials and goods within the mill complex was not a major consideration for the earliest mill builders and millwrights. Giles and Goodall (1992, 36) ascribed this to a period of technological inertia and certainly technology for hoists was not generally incorporated in Yorkshire textile mills until the mid-nineteenth century. But this research suggests, rather, that the evolution of the mill was, sometimes at least, a piecemeal process, and certainly the implications of moving raw materials and goods around the first generation of factories was not anticipated.

From the second quarter of the nineteenth the century it was common for Yorkshire textile mills to incorporate loading or taking-in doors on multi-storeyed buildings, external or internal hoists, and loading doors on single-storey structures. Firth's Mill, Lockwood, Huddersfield (**A5**, Figure 5.3: A172), built *c.*1830, incorporated a

Plate 66 *The projecting staircase tower at Firths Mill, Lockwood, incorporated taking-in doors at each floor level*

projecting stair tower with loading doors on each landing and communicating with each floor of the mill (Plate 66); at Saltaire Mills, Saltaire (**A8**), built 1850-3, a combination of external and internal hoists and taking-in doors allowed raw materials and goods to be moved around the mill complex as well as to and from the mill to the Leeds and Liverpool Canal; and, at Pecket Well Shed, Wadsworth (**A7**), built 1858, a round-headed taking-in door and external loading bay was provided in the south front of the weaving shed, whilst taking-in doors to each level of the multi-storeyed sizing block and warehouse were also provided. In later mills, taking-in doors and hoists were readily incorporated. At Ardsley Mills, East Ardsley (**A9**, Figure 9.3: A294), taking-in doors to each floor occupied the end bay at the east and west ends of the mill (Plate 67), whilst a mechanical hoist shared the projecting stair and privy tower, whilst a hoist at Park View Mills, North Bierley (**A11**, Figure 11.2: A343), connected the internal loading bay to storage areas in the basement of the shed, and a hoist at Frostholme Mill, Todmorden and Walsden (**A10**), provided a direct link between the sites sheds and multi-storey mill buildings.

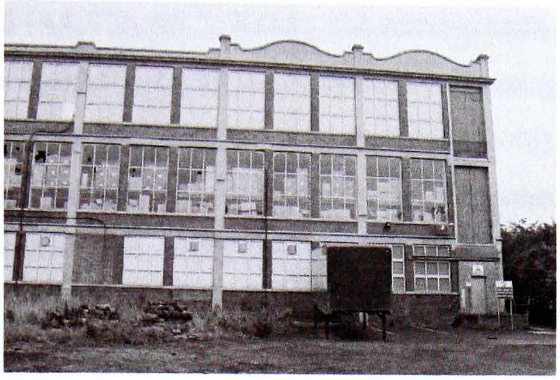

Plate 67 *Taking-in doors were provided at each end of the south elevation of Ardsley Mills, East Ardsley*

The implications of hoists and taking-in doors on the spatial configuration of the Yorkshire textile mill is clear from gamma maps plotting the movement of goods around middle and late period mills. Sites, including, Frostholme Mill, Todmorden and Walsden (**A10**, Figure 10.4: A329), Firths and

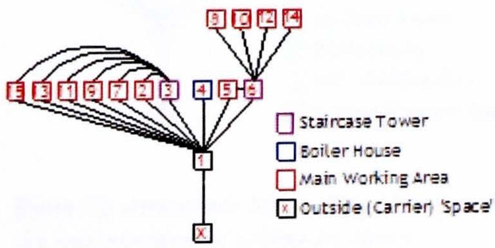

Plate 68 *Firths Mill, Lockwood: example of inherently ringy spatial complex resulting from presence of taking-in doors*

Britannia Mills, Lockwood, Huddersfield (**A5**, Figure5.7: A188), and Ardsley Mills, East Ardsley (**A9**, Figure 9.4: A303), are characterised by series of rings connecting different parts of the mill, in particular the main working areas at each site (Plate 68). Noticeably, most of these rings pass through the mill yard by virtue of the fact that either goods passed between floors via taking-in doors necessarily had to go outside in to the 'vertical' space of the mill yard before re-entering the mill, because goods had to cross the mill yard to get from one part of the mill complex to another, or because raw materials and goods generally entered and left the mill site through the mill yard.

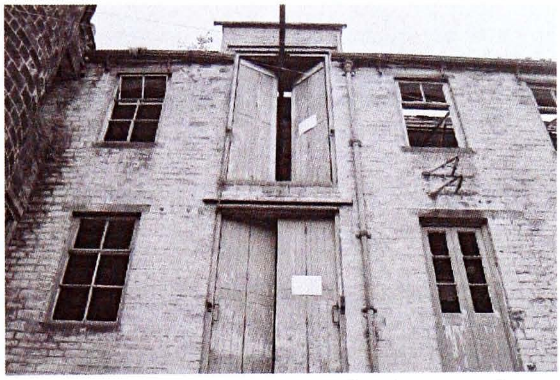

Plate 69 *Inserted hoist and taking-in doors, Aireworth Mill, Keighley*

However, the increasing attention paid to the provision of the movement of goods and raw materials around the Yorkshire textile mill complex is most noticeable in the adaptations made to early mills. At Aireworth Mills, Keighley (**A1**, Figure 1.7: A27), a hoist and taking-in doors were inserted into the north elevation in the late nineteenth century (Plate 69). These enabled goods to be passed between the floors of the mill and to and from the mill yard and removed the need to handle materials and goods internally. The effect of these additions on the movement of goods is clear from the resulting gamma map. The introduction of the hoist creates a series of rings from each floor to the internal hoist whilst the taking-in doors create further rings from each floor to the mill yard (**A1** Figure 1.10: A37; Figure 1.11: A40)(Plates 70 and 71). At the 1819 mill at Ebor Mill, Haworth (**A2**), and Gibson Mill,

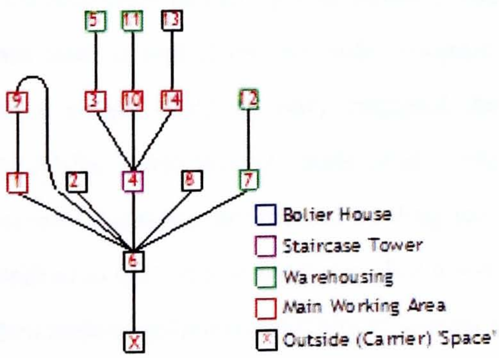

Plate 70 *Aireworth Mills, Keighley, prior to the introduction of taking-in doors*

Wadsworth (**A3**), the desire to introduce taking-in doors led to mill extensions, which, at both sites, involved goods being moved from the main working floors, into the extension and then to the taking-in doors. However, this extra internal movement was obviously perceived as advantageous in comparison to no taking-in doors at all.

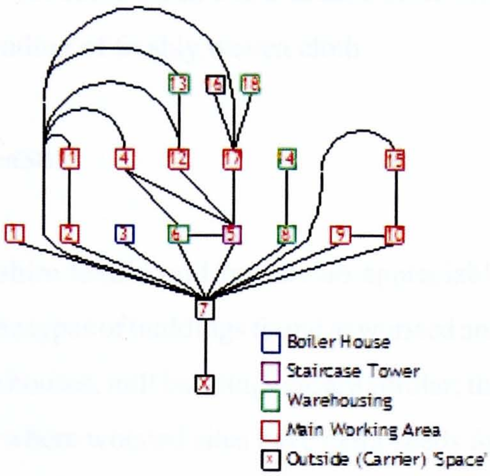

Plate 71 *Aireworth Mills, Keighley after the introduction of taking-in doors*

By plotting the potential movement of goods in the mill, an interesting observation about the evolution of the mill as a building type can be made. Giles and Goodall (1992) have noted that the shed found increasing use in later mills, partly reflecting the fact that many later mills were built as specialist weaving mills favouring the form of the shed, but also reflecting a growing appreciation of the flexibility of the shed as a building for industrial purposes. We may now, on the basis of the archaeological evidence from the Yorkshire textile industry, suggest that the single-storey shed was also preferable for it offered considerable advantages in terms of the movement of raw materials and goods within and to and from the mill complex. Housing processes on the same level within a single building only required the movement of goods horizontally. At Park View Mills, North Bierley, built 1924-5, the movement of goods occurred entirely within the mill including an internal loading bay. Of course, multi-storey mills continued to be built in to the twentieth century, but it was common for such mills to have fewer storeys, thus reducing their overall height and thus the vertical movement of goods. For instance, Ardsley Mills, East Ardsley, built in 1912, is a long, squat multi-storey mill with only three floor levels. Furthermore, it was increasingly common by the early twentieth century for multi-storey buildings to be built as warehousing rather than for the actual processes of production, such as Stadium Mills, North Bierley (**BFO62863**), built in 1912, whilst at Devonshire Mills, Keighley

(**BFO62300**), built 1909-10, the multi-storey warehouse block was also used other non-powered purposes such as offices and the mending of freshly woven cloth.

5.5 FUNCTIONALITY RECONSIDERED: A SYNTHESIS

The archaeological evidence from the Yorkshire textile mill reveals no appreciable difference in the construction of buildings or the types of buildings found at worsted and cotton sites. Spatially, configuration of engine houses, mill buildings etc are similar; the only real difference occurs in integrated sites where worsted sites have extra sheds for combing facilities. This is of interest for a number of reasons. First, it suggests a ubiquity in mill design regardless of the processes and industrial sector that it housed. This makes the textile mill a generic building type, of flexible form and capable of housing similar machinery. In part, we may attribute this to the technology that they housed. In terms of power and power transmission, there was no particular source of motive power or means of transmission favoured by either worsted or cotton (or other branches) - it could be applied to all. In terms of machinery, many of the developments in preparatory, spinning and weaving technology were developed first within one industry and then applied, with some modifications to other industries. In most sectors of the textile industry the greatest difference occurred at the preparatory stages, with different materials require different preparation. But between spinning and weaving there was less sectoral differentiation. Thus, the earliest spinning machines were similar sizes and, as we have seen, structural elements of the mill corresponded to these dimensions (a reflexive relationship).

Second, the degree of flexibility witnessed in mill design in Yorkshire is of interest to our understanding of the spread of the form. It has already been noted that the earliest mills share characteristics with earlier watermills and loomshops. There were ready parallels to copy. However, it is clear from documentary evidence that the archetypal early mill, the Arkwright-type mill was at least spread through the technology it housed. During the period of his patents (1771-85) Arkwright sold licences for units of a thousand spindles and it is clear that many early mills were designed to house machinery on this scale. Furthermore, mills built on Arkwright's system were something a phenomenon in their day and widely publicised (Chapman 1981-2, 10). As mechanised machinery became more widespread it was natural that mill owners and mill wrights would look to existing examples, particularly those that had become notable at a national level, like the Arkwright-type mill, and copy them. In addition, and here we reduce the mill to its most functional attributes, it was natural that the form of the mill would copy the machinery it housed. Thus there existed a reflexive relationship between the physical form of the mill and the technologies it housed.

Third, the apparent similarity between mills from different branches of the Yorkshire textile industries raises an interesting issue about flexibility of mill use. It is clear that at some sites mills were built for one branch but subsequently converted for use by another. At Britannia Mills, Lockwood, Huddersfield (**A5**), both the smaller, early Firth's Mill and the vast 1863 Britannia Mill, were built for the woollen industry. However, both were adapted, without any apparent structural alteration for use in the cotton industry supplying the local mixed worsted and cotton cloth industry, which emerged in the Colne Valley during the mid nineteenth century. Furthermore, when first built, Britannia Mills, Lockwood, Huddersfield (**A5**), was run as a room-and-power mill and several different branches operated cotton, worsted and woollen manufacture within the same building without any apparent difficulties arising from the design of the mill as a woollen mill. Furthermore, other structures were readily converted as companies switched between branches without any structural alteration. The first mill at Aireworth Mills, Keighley (**A1**), was built as a worsted mill and rebuilt in 1808, apparently incorporating elements of an earlier structure such as the wheelhouse, for cotton production capitalising on the cotton boom in the Keighley area in the early nineteenth century. However, the boom was short-lived and the site reverted to worsted production and the 1808 mill was unaltered. It is clear, however, that at many sites expansion was required to house more modern machinery and an increased output was demanded. Thus at Ebor Mill, Haworth (**A2**), the site was added to with increasingly large sheds and a large multi-storey mill, whilst at other sites the advent of the power loom, the vibrations of which generally precluded its use in multi-storey buildings, necessitated the construction of weaving sheds.

Finally, it is clear that some mill buildings in Yorkshire allowed a greater degree of flexibility in use than others. The use of the single-storey shed at mill sites had clear advantages over multi-storeyed buildings as it could easily be extended with minimal structural alteration. At Ebor Mill, Haworth (**A2**), and Pecket Well Shed, Wadsworth (**A7**), the weaving sheds were simply extended through the removal of one of the external walls. At Park View Mills, North Bierley (**A11**), the provision for expansion was expressed in the choice of building materials. The north facade and east wall of the shed were built in ashlar masonry whilst the south and west walls were built in red brick in anticipation of their removal and the extension of the shed in those directions. In the event, the west wall was partially removed when a modern office block was built to the west of the shed, but not during the use of the site for the manufacture of textiles. The shed was also more flexible in terms of the potential layout of machinery and had substantial advantages in the provision for flow-production as goods and materials could be moved laterally between stages of production rather than between floors and around the mill yard, as was the case with many multi-storeyed sites. This flexibility in use may account for its increased popularity over other forms of building from the early twentieth century onwards and its eventual selection for most modern industrial processes.

It is clear from this overview of the technological factors affecting mill design that there is clear archaeological evidence, from with the Yorkshire cotton and worsted industries, to support Markus' (1993) hypothesis that the form of the mill responded logically to functional attributes including the need to house a central source of power, the transmission of power throughout the complex, the layout of machinery and flow-production and the need to efficiently move raw materials and finished goods around the factory. Furthermore, the archaeological evidence suggests that the relationship between the physical form of the factory and these technological imperatives was reflexive, but the precise nature of this relationship is hard to distinguish in a period when mechanical and structural engineering was developing apace. Thus, it appears that whilst developments in machinery led to the need for larger factories in which they could be housed, developments in structural engineering allowed greater spans in buildings to be achieved and we might therefore consider that the possibility of these greater spans stimulated the development of larger machines. Furthermore, this research has found evidence to suggest that many elements of mill design, such as staircases, privies and overlookers' offices gradually moved out from the interior of the mill and were increasingly housed in projecting towers. This 'centrifugal' action further liberated the internal space available for machinery.

Furthermore, the archaeological evidence from Yorkshire suggests that the form of the mill responded to various technological changes and functional requirements in the mill in an almost experimental way. The advent of new technologies, such as increasingly large and sophisticated machines and developments in motive power sources and power transmission were absorbed into existing and new mills. This resulted in some mills having a piecemeal and organic evolution, such as Aireworth Mills, Keighley (**A1**), whilst others appear ahead of their time, such as Akroyd's experimental Old Lane Mill, Northowram (**A4**). The advent of steam power and changes to the means of power transmission from the line shaft to the rope drive provide two case studies of the way in which the form of mills responded to technological change. At many mills, engine houses were simply attached to existing structures, often resulting in complicated systems of power transmission or dual technologies of water and steam power in the same mill. Similarly, the development of the rope drive system saw many mills contrive a means of incorporating this new technology in to existing structures. Thus, at Aireworth Mills, Keighley (**A1**), the earlier engine house was re-used as a rope race whilst at Saltaire Mills, Saltaire (**A8**), those features associated with the first system of power transmission, such as underground shaft tunnels, were readily adapted for housing group drive electric motors. A further, explicit example is seen in the evolution of systems for moving goods and materials around the mill. From the mid nineteenth century many early mills were altered to incorporate hoists and taking-in doors, whilst newly built mills readily incorporated such features as standard. This highlights an important issue about the evolution of the mill as a building type. This research has found evidence to suggest that the movement of materials and goods around earlier mill was not anticipated and at many early sites the difficulties of handling and moving materials and goods within a multi-storeyed building were not resolved until the mid-nineteenth century when considerable effort was made at many sites to introduce hoists and taking-in doors.

In contrast, some new Yorkshire textile mills tended to be built incorporating the latest technology. Thus, Old Lane Mill, Northowram (**A4**), and Saltaire Mills, Saltaire (**A8**), stand out as 'ideal' mills for their time and were revered as such by contemporaries. Both took advantage of the latest advances in steam technology and power transmission and structural engineering and both were experimental in terms of design – Old Lane Mill, because it was an early trial in the installation of power looms in a multi-storey building and incorporated a loading bay, and Saltaire Mills because of its scale, the organisation of worsted production and its close association to a model worker settlement. Other mills, like the electric powered Park View Mills, North Bierley (**A11**), were less iconic, but nevertheless built to the latest standards. However, it is also clear that we should not expect all new mills to accurately reflect the latest technologies. Whilst Ardsley Mills, East Ardsley (**A9**), used the latest structural engineering, the Hennibique reinforced concrete frame, it still incorporated a steam engine and rope drive rather than electric power that might have been expected in 1912. It is therefore clear that in choosing the design of a mill a number of practical and economic factors came in to play, not least financial considerations. Furthermore, it is also clear that we should not expect to find that the development of mill design was a continually progressive, linear process. It clearly was not so.

Crudely expressed, the Yorkshire textile mill responded to technological factors in a number of different ways. At the majority of sites technological change over time was readily absorbed into existing buildings, whilst new buildings and sites were clearly designed with technological advances in mind. This suggests that the form of the mill evolved in tandem with the evolution of technology and in itself this statement is true. However, when this evidence is compared with the rather more static and unmoving evidence for the social use of space (Chapter Six) and use of meaningful architecture in the mill (Chapter Seven), the different practical and social functions of the mill become particularly clear. From an archaeological perspective it is this complex interplay of different factors acting on the physical form of the mill that is particularly exciting, and it is in within this contextual model of the mill that the purely technological and functional aspects of the design of the mill have their greatest contribution to make our broader understanding of the physical form of the factory.

CHAPTER SIX
THE TEXTILE MILL -
SOCIAL SPACE

> *'It is the fact of space that creates the special relation between function and social meaning in buildings. The ordering of space in buildings is really about the ordering of relations between people'* (Hillier and Hanson 1984, 1-2)

6.1 INTRODUCTION

Our understanding of the mill, at its most basic, may be reduced to that a building designed to house the processes of production and the workforce operating machinery. It is these functional characteristics that partly define the factory as a distinctive building type and which, within that broader category, defines different types of factory based on the industrial sector to which they belonged. In the preceding chapter (Chapter Five) the evidence for the ways in which purely technological and functional factors determined the form of the mill was explored. This chapter will now consider how the spatial evidence from the mill may be interpreted in terms of labour relations and its implications for social practice within the textile factory considered (the bulk of the evidence has been drawn from the case studies presented in Appendix A). Underlying this close examination of the physical evidence is the belief that there were aspects of mill design that reflected the need to impose control over the workforce through supervision and the maintenance of hierarchical labour relations. In turn, these relations within the mill are seen as a direct reflection, indeed a microcosm, of wider social relations during the industrial revolution. The following chapter (Chapter Seven) will then move on to specifically explore the evidence the qualitative aspects of mill architecture and a consideration of the social significance of the choice of stylistic and symbolic motifs; where appropriate will it draw on the spatial evidence revealed in this chapter.

The idea that space within the textile mill was configured in such a way that it actively structured labour relations implies that it was designed to be authoritarian. This has clear parallels with the work of Weber (1927) and Murphy (1988) and 'Closure Theory', which concentrates on the ways in which individuals within society attempt to bolster their position by acting as a group. This may involve upward mobility through usurpation or the exercise of power downwards to control or restrict other groups. The latter concept is of particular interest to this research and it is suggested that the mill, as a physical structure, played a crucial role in that process of control.

Of course, it is important to define the different groups that we would expect to see affected by these social processes. First, the mill is clearly expected to reflect the requirements and demands of the industrialist or mill owner. If we accept models of the factory system that suggest it emerged because of the organisational and microeconomic benefits of a centrally organised workforce that could be easily supervised, then we would expect the mill, as a physical entity, to structure and reproduce those hierarchical labour relations, allowing the maintenance of power structures and the effecient supervision of workers. Accordingly, the mill is viewed as a material mechanism through which relations between the capitalist and working classes were created and reproduced. This is a singularly important point for it suggests that the textile factory was a *locale* within which a wider 'field of discourse' – the redefinition of class relations following the advent of industrialisation – was played out.

Second, the mill might also be considered a *locale* for the development of the working class consciousness by virtue of the fact that it was a location in which workers were brought together. This discourse has important spatial implications for the idea of mill architecture as authoritarian, for it would be in the interests of the mill owner or capitalist to limit the possibility of the factory to becoming a location for the potential emergence of anti-capitalist feeling. This implies the possibility of an inherent tension between different social groups within the workplace and it is suggested that evidence for this may well be evident in the built fabric of the mill. If so, it will reveal how successful the mill was in structuring labour relations and, therefore, its effectiveness as a medium through which to impose strategies of social control.

Third, it may also be expected to find that the spatial form of the mill reflected business relations, thereby structuring relations between the company operating the mill and the client purchasing its product, as well as relations between rival textile producing firms. The mill, as the seat of manufacture, was the physical representation of the company that operated from it and it might therefore be expected to find that provision was made in the layout of the mill for clients to visit the mill in order to carry out business. In this sense the mill is a *locale* for the wider discourse of business relations. The use of space in this capacity is not expected to have been used in an authoritarian way, but rather that there will be spatial evidence for the incorporation of the business aspects of textile production, such as visits from clients, into the complex as a whole.

6.2 THE TEXTILE MILL: A GENERIC TYPE

Across the age of mill building in Yorkshire, from c.1780 to 1930, the spatial form of the mill remained remarkably consistent. Despite changes to power sources, the means of power transmission, the scale of manufacture, date of construction or branch (here the cotton and worsted sectors), a clear spatial pattern emerges which characterises both individual buildings and the mill complex as a whole (see Chapter Five). The Yorkshire evidence has revealed a trend whereby these functional attributes led the form of the mill to act in a centrifugal action with functional elements gradually moving away from the work floor to the edge or outside of the building, such as staircases and privies housed in projecting towers. In contrast, the spatial form of the mill may be seen to have acted in reverse, a centripetal action, with the increasing intensification of the possible control exerted over the movement of people within the mill and potential social interaction. This has analogies, though working in the opposite way and with the opposite effects to the centrifugal and centripetal forces observed by Girouard (1978).

Generically speaking, and in terms of gamma mapping, the inherent spatial structure of the mill conforms to a basic tree-like form, and this is true both of individual buildings complex and of entire complexes in Yorkshire. The defining characteristics of this spatial genotype are based on the fact that a high percentage of spaces within the complex are accessible from only a limited number of other spaces at the

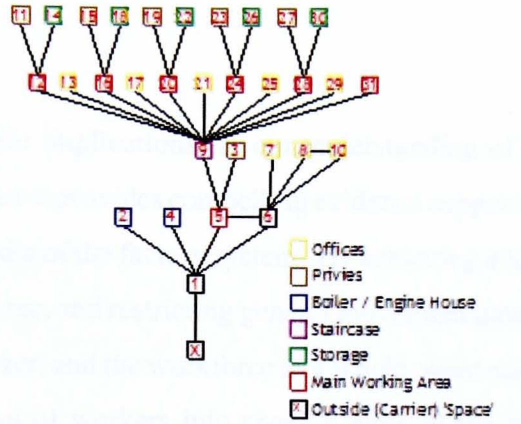

Plate 72 *The typically branching spatial structure of the textile mill, Old Lane Mill, Northowram*

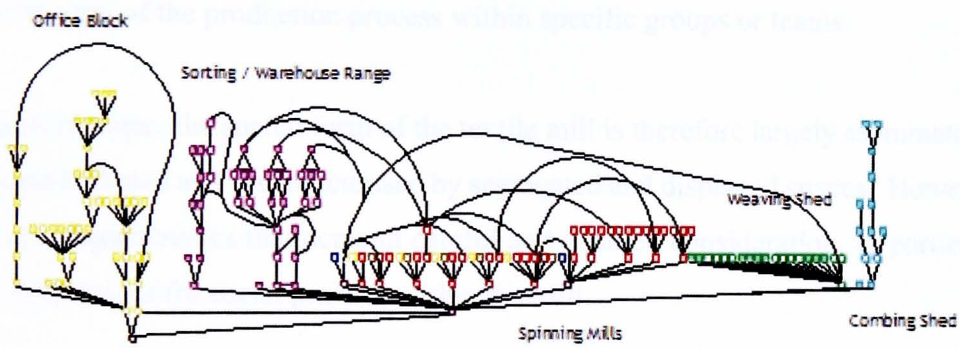

Plate 73 *Saltaire Mills, Saltaire: the whole complex and individual buildings have an inherently dendritic spatial structure*

base of the structure, as at Old Lane Mill, Northowram (**A4**, Figure 4.5: A157) and Saltaire Mills, Saltaire (**A8**, Figure 8.2: A284) (Plates 72 and 73). Furthermore, it is usual for the structure to adopt the appearance of an inverted pyramid with only a very limited number of spaces (most often only one) at the base of the structure. This results in an inherently branching spatial structure in which movement about the interior of the complex or building and in relation to the exterior is highly restricted. Additionally, because the majority of spaces within the structure are segregated from each, most having only one or two neighbours, this spatial form is formally, as well as intuitively, a powerful way of controlling movement and achieving the segregation of the greatest number of people.

This generic spatial form has considerable implications for our understanding of the textile mill as a workplace, not least because it provides compelling evidence supporting organisational and microeconomic accounts of the factory system. By achieving a high degree of segregation amongst the workforce, and restricting general movement around the mill, the actions of the individual worker, and the workforce as a whole, were easily supervised. Furthermore, the segregation of workers into specific parts of the mill broadly mirrors the distribution of processes throughout the textile factory (Chapter Five) and engenders a teamwork ethic amongst workers with specific responsibilities. This creates an environment suited to the transfer of skills and knowledge about different parts of the production process within specific groups or teams.

As a generic type, the spatial form of the textile mill is therefore largely asymmetrical and nondistributed and is characterised by segregated and dispersed spaces. However, these are characteristics that demand careful and detailed consideration, in particular their implications for social practice within the mill.

6.2.1 INTEGRATING SPACES

By virtue of the fact that the spatial form of the mill conforms to a tree-like structure, there will be spaces at the base of the structure which either provide direct access to the majority of other spaces within the complex or which are central to the route taken in order to access spaces in the deeper parts of the complex (that is, those furthest from the initial point of entry into the spatial structure). These spaces may be said to integrate the complex as a whole – they tend to have at least two neighbouring spaces and an RA value lower than the average RA value for the entire complex.

Within the context of the Yorkshire textile mill two areas of the factory consistently provide the means of access to the majority of other spaces within the complex and have a low RA value. These are the mill yard and the staircase tower.

6.2.2 THE MILL YARD

The majority of mill sites in Yorkshire were constructed around a mill yard. It was usual for the yard to occupy a central position within the site with buildings built around each side; this was especially common and at large-scale and integrated sites. A Saltaire Mills, Saltaire (**A8**, Figure 8.1: A266), the mill yard was an elongated open space behind the main multi-storeyed block whilst at Ebor Mill, Haworth (**A2**, Figure 2.1: A56), the integrated complex developed around a square cobbled yard. In the case of early mills where the number of buildings was usually limited, the yard might be partly defined by a low enclosing wall, as was the case at Aireworth Mills, Keighley (**A1**, Figure 1.1: A2) (Plate 74). At other sites, the main mill building occupied a central position within the yard, enclosed by tall walls, as at Old Lane Mill, Northowram (**A4**, Figure 4.1: A130). At some sites the mill yard was less obviously demarcated but in such cases it was usual for an enclosed area around the mill to be defined by some other means. For instance, Gibson Mill, Wadsworth (**A3**, Figure 3.1: A96), has no enclosed yard but a common lane to the east and the Hebden Water to the west define the complex including main mill building and workers cottages whilst access through the site is regulated by the

Plate 74 *The mill yard at Aireworth Mills, Keighley, was defined by the main mill buildings and a low perimeter wall with gateway entrance*

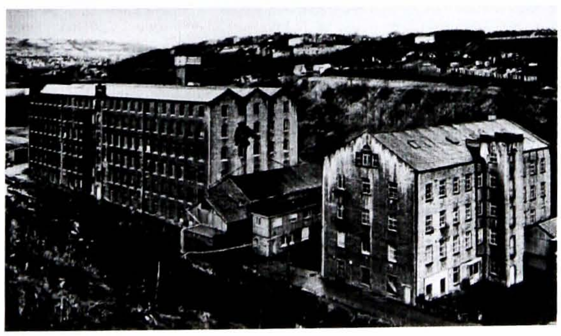

Plate 75 *The natural topography at Britannia Mills defines the mill site located between the River Colne and the Huddersfield Canal*

presence of a toll bridge. At Britannia Mills, Lockwood, Huddersfield (**A5**, Figure 5.1: A165)(Plate 75), the natural topography of the site, which is located at the bottom of a deep river valley with steeply rising ground to the north south and located on a spur of land between the River Colne and the Huddersfield Canal, defines the area around both of the mid-nineteenth century mills in addition to low masonry walls defining the entrance to the site.

There are clear technological and functional reasons for this arrangement. The mill yard assisted the logical flow of materials and goods into, around and away from the site of production. Furthermore, the enclosed character of the mill yard and the control of access into and from the mill were important in terms of security. In many early mills, particularly those owned by key innovators in the industry, like Richard Arkwright at Cromford, security was major issue in a climate when it was necessary to protect mechanised machinery and to keep new inventions secret (Menuge 1993, 56). In addition, throughout the age of mill building general security was a concern and an account of the attempted robbery of worsted tops from Aireworth Mills, Keighley (**A1**), in the 1820s (Hodgson 1879, 181), serves as an acute reminder of the value of raw materials, finished goods, and machinery at textile producing sites.

However, the arrangement of the mill around an enclosed yard also has a social logic. It physically controlled the movements of the workforce – workers entered the mill site, worked within the confines of the factory and then left. The positioning of time offices next to the mill gates was a means of reinforcing the effectiveness of this control, as was the positioning of the mill owner's office overlooking the

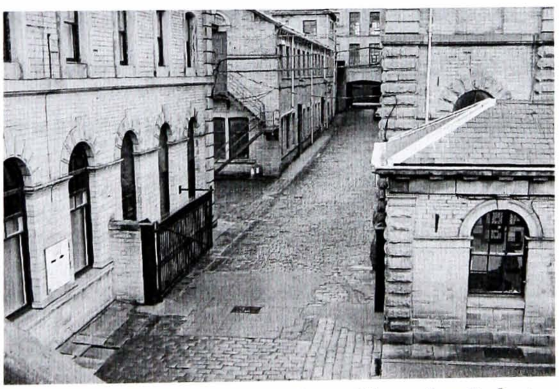

Plate 76 *The entrance to the mill yard at Saltaire Mills, Saltaire, was controlled by a gateway and time office*

main approach and entrance to the mill, as is neatly illustrated at Saltaire Mills, Saltaire (**A8**, Figure 8.1: A266), where not only was there a time office at the entrance to the mill yard but the entrance itself was overlooked by Sir Titus Salt's own office (Plate 76). Oral history (**A0042**, B77-B78; **A0085**, B86) records punishment for being late to work and in order to impose such penalties the entrance to the mill needed to be highly visible. Furthermore, as the mill yard was easily visible from the interior of the surrounding mill buildings potential seditious activity between workers was dissuaded.

The enclosed form of the mill therefore performed a distinct social function. Belford (2004) argued that the enclosed industrial complex has its origins in a subtle awareness of enclosed medieval spatial forms, such as the monastic cloister and collegiate quadrangle, which had a symbolic and physical defensiveness and, particularly in the case of the monastic enclosure, represented contained space devoted to spirituality. Belford (2004, 59) concluded that the form of the enclosed industrial complex reflected that 'rational productivity was (and remains) part of the god-fearing protestant ethic) and therefore looked back to medieval spatial forms based on an protestant ideology. The extent to which the concept of the 'protestant ethic' can be related to the archaeological evidence considered in this research is questionable but outside of the boundaries of this thesis. However, it is clear that the enclosed form helped establish new working practices, both physically and psychologically, and it may therefore have looked back to earlier and existing forms of enclosed space where the benefits of bounded space for supervision had already been experimented with. Because the factory was an enclosed and controlled space it physically emphasised the increasing separation of the home from the workplace (Mokyr 2001, 8), the substitution of control over the production process by capitalists rather than workers, and wider transformations during the period such as changing wage trends and the shift from task to time discipline (see, for instance, Thompson 1967; Kussmaul 1994; Voth 2000). This has clear resonances with Bourdieu's *habitus* and Gidden's Structuration theory – the factory is revealed as *locale* of work in which the physical structure formally and intuitively imposed a new way for the individual and the working class to 'go on in life' – work based on mass, centralised production. There is then a relationship between the emergence of the spatial form of the factory and significant changes to the pattern of work and leisure for the working classes.

6.2.3 STAIRCASE TOWERS

The emergence of the staircase tower was one of the major spatial changes to occur to the textile factory. In many early multi-storey mills it was common for access to the main working floors to be via internal flights of stairs between each floor of the mill. This was the case at Aireworth Mills, Keighley (**A1**, Figure 1.3: A9), in the 1819 mill at Ebor Mill, Haworth (**A2**, Figure 2.3: A61), and remains the case at Gibson Mill, Wadsworth (**A3**, Figure 3.3: A101; Figure 3.9: A123). This led to linear strands emerging with the spatial structure of the mill and meant that access to the top floor of a mill was via each of the floors below (Plate 77).

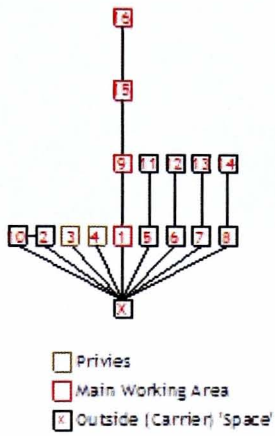

Plate 77 *Typical linear sequence of main working areas (the spinning mill, c.1800) at Gibson Mill, Wadsworth*

However, some of the more experimental early mills, and most mills built after c.1829 employed a staircase tower. The staircase tower usually occupied one of two principal positions in the mill. In some mills it rose inside the mill, often within a bay of building

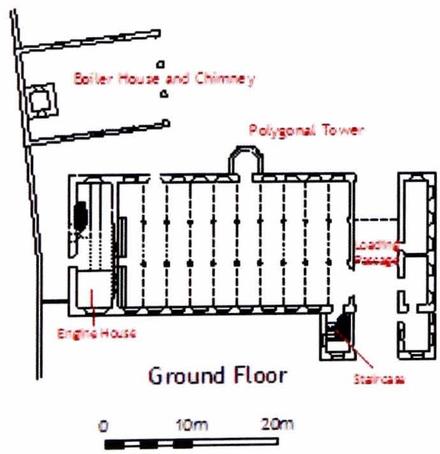

Plate 78 *Plan of Old Lane Mill, Northowram, showing staircase located in the wing*

that already housed other features (such as engine houses, privies, or offices), and was therefore not useful as a space in which to house the processes of production. Thus at Old Lane Mill, Northowram (**A4**, Figure 4.2: A137)(built 1825-8) the staircase tower rose within the wing of the mill which also housed small offices on each floor and meant that the main floors of the mill provided uninterrupted working space (Plate 78). Alternatively, and increasing commonly after the mid-nineteenth century, the staircase tower was housed in a projecting tower and was thus entirely removed from the main space within the mill. This was the case at Britannia Mills, Lockwood, Huddersfield (**A5**, Figure 5.3: A172; Figure 5.4: A177),(c.1830 and 1861; Plate 79), Victoria Mills, Elland (**A12**, Figure 12.3: A377),(1898), and Ardsley Mills, East Ardsley (**A9**, Figure 9.3: A294), (1912).

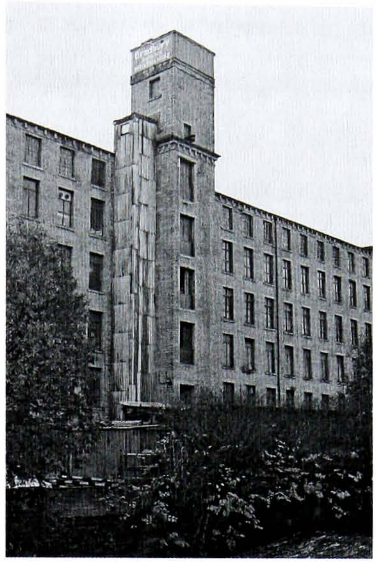

Plate 79 *Projecting staircase tower, Britannia Mill, Lockwood*

Regardless of its physical position within the multi-storeyed mill building, the staircase tower had a profound effect on the movement of individuals around individual buildings within the mill complex. Spatially, the staircase tower, like the mill yard, integrated the complex as a whole. It was located at the base of the spatial structure and usually provided direct access from the mill yard to the main working spaces within the mill. Furthermore, its RA value consistently falls well below the average RA of the complex indicating that spatially the staircase tower integrates the complex as a whole (Table 5):

TABLE 5 *TABLE OF RA VALUES FOR STAIRCASE TOWERS*

MILL	PERIOD	MEAN RA OF STAIRCASE TOWERS	MEAN RA OF COMPLEX
Aireworth Mill, Keighley (**A1**)	EARLY	-	0.256
Ebor Mill, Haworth (**A2**)	EARLY	-	0.289

Gibson Mill, Wadsworth (**A3**)	EARLY	-	0.246
Old Lane Mill, Northowram (**A4**)	EARLY	0.054	0.145
Britannia Mills, Lockwood (Firths Mill) (**A5**)	MIDDLE	0.083	0.272
Dunkirk Mill, Oxenhope (**A6**)	MIDDLE	-	0.476
Pecket Well Shed, Wadsworth (**A7**)	MIDDLE	-	0.254
Saltaire Mills, Saltaire (**A8**)	MIDDLE	0.051	0.069
Ardsley Mills, East Ardsley (**A9**)	LATE	0.063	0.163
Frostholme Mill, Todmorden and Walsden (**A10**)	LATE	0.078	0.156
Park View Mills, North Bierley (**A11**)	LATE	-	0.168
Victoria Mills, Elland (**A12**)	LATE	0.066	0.203

The spatial effect of the staircase tower was most obvious at early sites where a later stair tower is added to replace stairs rising between each floor of the mill. At Aireworth Mills, Keighley (**A1**, Figure 1.5: A16), the 1808 mill was built with stairs rising between each of the floors of the mill but a projecting staircase tower replaced this arrangement in the mid-nineteenth century (Plate 80). The addition of the staircase tower transformed the spatial structure of the mill (**A1**, Figure 1.12: A43; Figure 1.13: A45)(Plates 81 and 82). Notably, the staircase tower became *the* principal means of access to the spinning mill, whilst the mill yard became the principal means of access around the mill complex as a whole. Furthermore, the staircase tower integrated the spatial structure of the multi-storey spinning mill

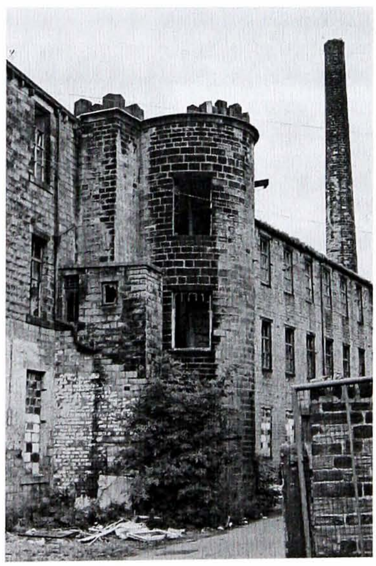

Plate 80 *Projecting staircase tower added to Aireworth Mills, Keighley in the mid-19th century*

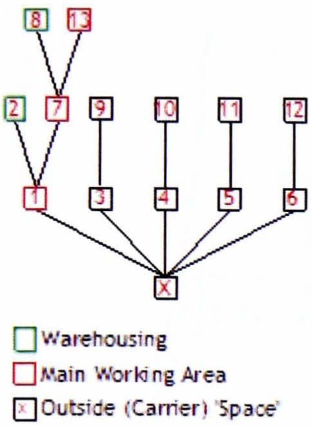

Plate 81 *Spatial structure of Aireworth Mills, Keighley c.1808*

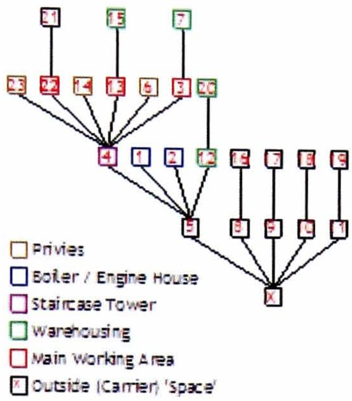

Plate 82 *Spatial structure, Aireworth Mills, Keighley, in the mid-19th century following addition of staircase tower*

so that, with the exception of the internal end engine house, which was accessed directly from the mill yard, all other spaces within the spinning mill were accessed from the staircase tower and not from other working floors within the mill.

The benefits of the staircase tower as a means of improving general movement within the mill are evinced by the large number of sites where they were added to existing structures, or incorporated into the design of newly-built mills after c.1829; indeed, after that date it became a standard, if not a defining feature, of the Yorkshire textile mill. At Ebor Mill, Haworth (**A2**, Figure 2.6: A70) (Plate 83), the small 1819 spinning mill underwent successive enlargement during the mid-nineteenth century. The reasons for the enlargement of the mill were two-fold – one to improvement the movement of goods around the building and, second, to add an internal staircase in the last bay of the building providing access to all the main working areas above ground floor level.

The spatial role of the staircase tower is interesting for several reasons. First, it effectively removed the vertical aspect from multi-storey mill buildings. In other words, for each floor, regardless of its position and height of the building, was spatially equal to any other floor within the building, and each floor was accessible from the same

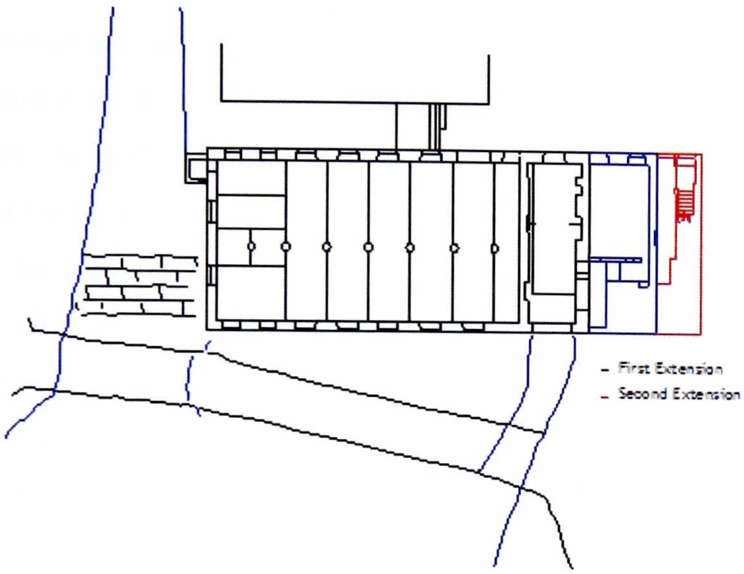

Plate 83 *Successive extensions at the east end of Ebor Mill (c.1819) during the mid-19th century improved the systems of moving materials and goods as well as human movement about the building*

space, the staircase tower. This not only made movement to the working floor easier but it also reduced the need for workers to pass through most of the other working spaces within the mill in order to get to their place of work. It also had a major implication in terms of movement around the mill. In this way and, second, it restricted the movements of workers thereby making supervision easier. Because workers could move directly from the exterior of the building in to the staircase tower and then to their place of work (machinery in the main working floors), their movement was restricted to an average of three spaces within the complex. Third, because the staircase tower removed the need for the main working areas of the mill to be part of the means of movement around the mill, it allowed different elements of the production process and different sections of the workforce to be increasingly segregated from each other. Thus the staircase tower was a powerful material mechanism that enabled the supervision and segregation of the workforce. This contrasts markedly with the evidence for the movement of materials and goods around the mill complex (see Chapter Five) which was designed to be as efficient as possible and was based on establishing as many links as possible between interior and exterior spaces.

The extent to which the staircase tower was used as an instrument of control in terms of potential human about the mill was enforced by the positioning of overlooker's offices and time offices directly adjacent to the landings of the staircase or next to the point of access from the staircase to the main working floor. Thus at Old Lane Mill, Northowram (**A4**, Figure 4.2: A137), (1825-8), and Ardsley Mills, East Ardsley (**A9**) (1912) overlooker's offices opened on to the landings of the staircase at each level within the mill, whilst at Saltaire Mills, Saltaire (**A8**), the overlooker's office for each floor in the western half of the lower three storeys of the main spinning range was located adjacent to doorway between the staircase and the main working area. In such mills, the position of the overlooker's office was clearly contrived to further impose restrictions on movement to and from the staircase and the main working areas. Thus, those workers with a supervisory role occupied distinct parts of the mill, which were often located close to the principal means of access and this has clear parallels with the work of John Peponis (1983; 1985), who observed that supervisors occupied distinct spaces, such as offices, but which were close to and had a view over each of the main working areas in the factory. Consequently, the hierarchical structure of the workforce was reflected in the allocation of spaces for different workers to inhabit and their position within the spatial structure of the mill as whole reflected the requirements of their job.

The staircase is also of particular interest because it reveals something of the process of the development of the mill as a distinctive building type. It has already been shown (see Chapter Five) that, over time, there was a tendency for elements of the mill, such as water closets and staircases, to be housed in 'redundant' bays of the building (which housed a number of different features such as waterwheels, engine houses, offices and staircases) or in projecting towers which freed the main working areas of the mill from obstructions, maximising the available space. This may be viewed as the centrifugal movement of elements of the mill to the outside of the building. However, as we have seen the staircase tower heightened the amount of control that could be exerted over the movement of workers and this intensification with an increasing emphasis upon internal movement may be seen as a centripetal motion. Thus functional aspects of mill design tended towards the dispersal of certain spaces in the mill to the exterior of building, but this centrifugal action resulted in more efficient systems of social control.

Of course, the staircase tower was not universally applied to the buildings of the Yorkshire textile mill, and it tended to be used mainly in structures of over three storeys where there were greater benefits in providing direct access to elevated spaces. Thus, at Aireworth Mills, Keighley (**A1**, Figure 1.3: A9), only the spinning mill had a staircase tower whilst other two-storey buildings within the complex incorporated open flights of staircases between the ground and first floor. Likewise, at many smaller mills the staircase tower was never built into the original design or added later. Thus at Gibson Mill, Wadsworth (**A3**, Figure 3.3: A101), continued to use open staircase between each of its floors throughout its life as a textile producing site whilst access between the three floors at Dunkirk Mill, Oxenhope (**A6**, Figure 6.1: A207), was via open stairs even after the mill was rebuilt in c.1870 (Plate 84).

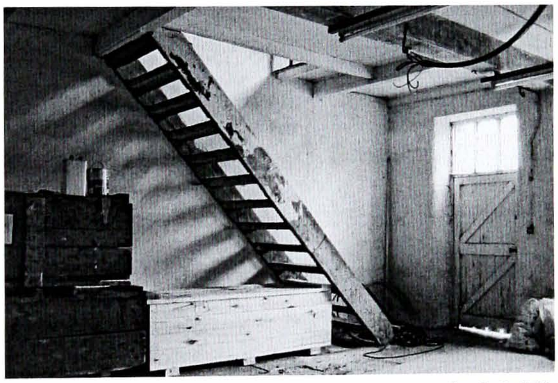

Plate 84 *Open internal staircase, Dunkirk Mill, Oxenhope*

In the case of single-storey sheds the staircase tower obviously did not fulfil a role in the movement of workers. However, similar control over movement was imposed in one of two ways. First, it was common for corridors to be constructed within the shed directing the movement of workers from the exterior to the main working areas in the same way as staircase towers did. This was the case at Park View Mills, North Bierley (**A11**, Figure 11.2: A343; Figure 11.5: A361), built in 1925, where a corridor leading from the workers entrance to the mill leads to a further corridor positioned transversely across the mill and providing access to water closets and the main working areas (and

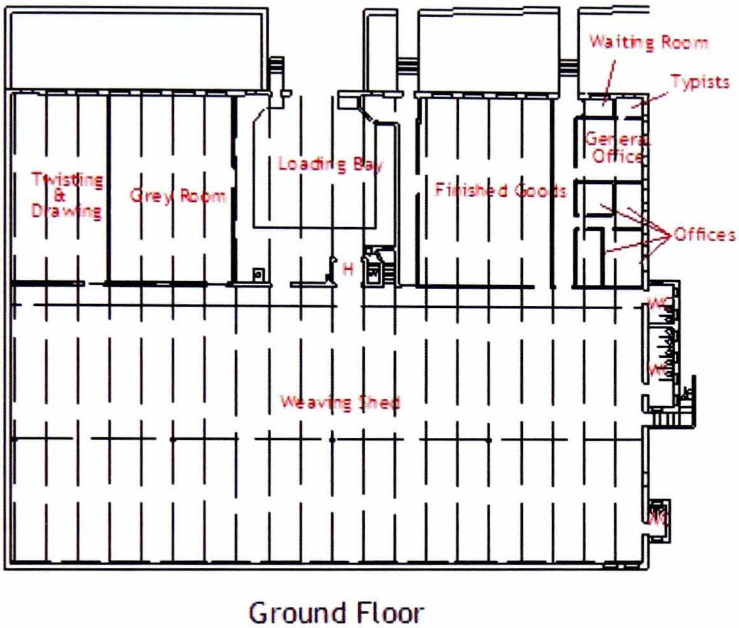

Plate 85 *Ground floor plan of Park View Mills, North Bierley, showing corridors within the shed proving the main means of access to different parts of the mill*

a staircase leading to the basement; Plate 85). Spatially, these corridors shared the same characteristics as staircase towers. Second, and more commonly, the mill yard remained central to the spatial complex, as at Pecket Well Shed, Wadsworth (**A7**, Figure 7.7: A257)

6.2.4 WORKING AREAS AND PRIVIES

Of course, a major feature of the mill was the workfloor in which the processes of production were housed. On the basis of evidence from Yorkshire, the main working areas are, when shown on justified gamma maps, generally located immediately adjacent to one of the principal integrating spaces within the complex, such as the mill yard or staircase tower, reflecting both the movement of goods and materials to and from the workfloor (Chapter Five) and the movement of people from the exterior of the mill to their place of work, as in the 'New Mill', Ebor Mill, Haworth (**A2**) (Plate 86)

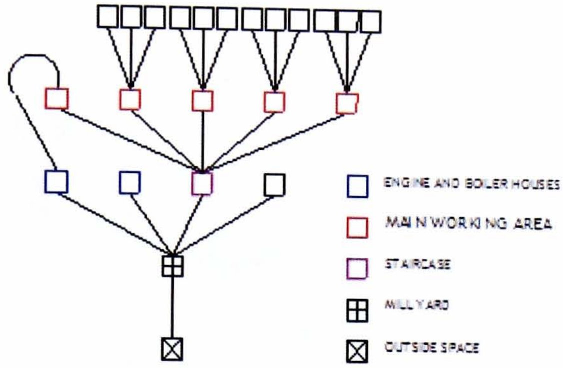

Plate 86 *The 1887 'New Mill', Ebor Mill, Haworth: typically the main working areas were accessed from a main staircase*

At many early sites in Yorkshire, the work floor appears as a terminal space on gamma maps, as at Firth's Mill, Britannia Mills, Lockwood, Huddersfield (**A5**, Figure 5.9: A195) (Plate 87). This reflects the relative simplicity of the first generation of mills, the design of which was not influenced by the Factory Acts and legislation which, from the second quarter of the nineteenth century, increasingly brought about increased attention to sanitary provisions and the nature of working conditions (Hutchins and Harrison 1911; Henriques 1971). Accordingly, with a few exceptions that largely represent the leading mills of their time, such as Strutt's North Mill, Belper, Derbyshire, and Old Lane Mill, Northowram (**A4**), most early mills comprised working areas and a waterwheel. The workfloor was therefore the deepest part of the complex.

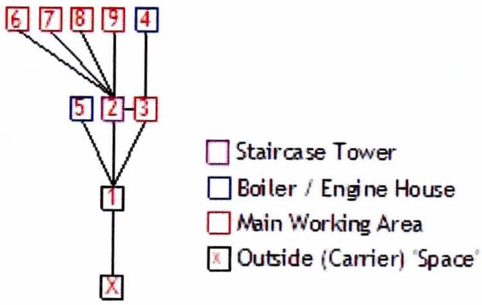

Plate 87 *At Firths Mill, c.1830, the main working spaces are located in the deepest part of the complex and appear as terminal spaces*

After the early nineteenth century the number of additional spaces that appear at mill complexes, both in terms of newly built mills and additions made to earlier structures, increases. The principal development was the addition of the water closet, which was usually accessed directly from the main working areas and therefore became the deepest spaces in the complex, as at Old Lane Mill, Northowram (**A4**, Figure 4.5: A157) (Plate 88). At Saltaire Mills, Saltaire (**A8**) and Pecket Well Shed, Wadsworth (**A7**, Figure 7.3: A243), the privies were located in projecting structures adjacent to each of the main working areas, whilst at Ardsley Mills, East Ardsley (**A9**, Figure 9.3: A294), and Victoria Mills, Elland (**A12**, Figure 12.3: A377), the privies were incorporated in the staircase tower.

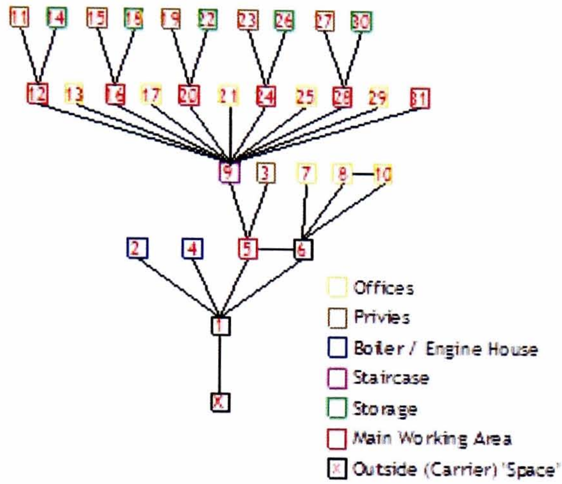

Plate 88 *Typically, privies were located in the deepest parts of the complex, as seen here at Old Lane Mill, Northowram*

However, despite that fact the addition of spaces such as the water closet to the workfloor, the main working areas of the mill did not become integral to overall movement about the mill complex. This much is clear from the RA values of the main working areas compared to integrated spaces such as staircases, corridors and the mill yard (Table 6):

Table 6: *Comparative RA values of the main working areas, staircase towers, corridors and mill yards*

MILL	PERIOD	MEAN RA OF MAIN WORKING AREAS	MEAN RA OF STAIRS/ CORRIDORS	MEAN RA OF MILL YARD	MEAN RA OF COMPLEX
Aireworth Mill, Keighley (**A1**)	Early	0.299	-	0.059	0.256

Ebor Mill, Haworth **(A2)**	EARLY	0.388	-	0.154	0.289
Gibson Mill, Wadsworth **(A3)**	EARLY	0.312	-	0.083	0.246
Old Lane Mill, Northowram **(A4)**	EARLY	0.107	0.054	0.123	0.145
Britannia Mill (Firths Mill), Lockwood **(A5)**	MIDDLE	0.278	0.083	0.139	0.272
Dunkirk Mill, Oxenhope **(A6)**	MIDDLE	0.444	-	0.267	0.476
Pecket Well Shed, Wadsworth **(A7)**	MIDDLE	0.291	-	0.125	0.254
Saltaire Mills, Saltaire **(A8)**	MIDDLE	0.061	0.051	0.028	0.069
Ardsley Mills, East Ardsley **(A9)**	LATE	0.141	0.063	0.094	0.163
Frostholme Mill, Todmorden and Walsden **(A10)**	LATE	0.141	0.078	-	0.156
Park View Mills, North Bierley **(A11)**	LATE	0.138	-	0.145	0.168
Victoria Mills, Elland **(A12)**	LATE	0.182	0.066	0.118	0.203

It can be seen that although the RA of the working area of mills tends to be similar to the mean RA for the entire complex, it remains higher for spaces such as the staircase tower and mill yard which actively structure movement about the complex. Furthermore, the RA value of working areas in earlier mills is higher than that in middle and late period mills and this reflects the fact that at these later sites the working floor provided limited access to other spaces such as privies. Nonetheless, at a general level, the role of the main working area in relation to overall movement around the mill is negligible.

The relationship of the working floor and privies is worthy of further consideration. The fact that privies were generally provided next to each of the main working areas rather than a single privy block being provided at the mill site reveals an interest in minimising

Plate 89 *Projecting privy block, Park View Mills, North Bierley*

the time spent by workers away from the production process. Although a single privy block at ground floor has considerably fewer structural implications and, importantly, would have been cheaper to build, effort was made to ensure that each working area had its own sanitary provisions. A particularly compelling example is seen at Park View Mills, North Bierley (**A11**, Figure 11.2: A343), where the main privy block (with direct access to both the main weaving area and the suite of administrative offices) was built on stilts (Plate 89) in order that the privies were adjacent to the main working areas rather than built at basement level (which, because of the fall of land across the site, appears at ground level) where access from the main working areas would have been more difficult.

The provision of sanitary facilities in the deepest parts of the complex also conforms to the idea that spaces furthest from the outside of the building are inherently the most private. However, oral history tells a different story and several interviewees who had formerly worked in the Yorkshire textile industry recalled that the mill privy was not a private space. For instance:

> 'I mean, toilets were... no doors on the toilets, not proper doors, just half a door, you know, and if the boss thought you'd been there too long he used to come on and he could just look over the door to see whatever you were up to, you know' (**A0009**, B41).

Furthermore, many mill rules stipulated that only one person was allowed in the privy at any one time. No physical evidence of this sort was noted during this research, but the degree to which workers using privies could be supervised is suggested at many sites, like the 1887 spinning mill at Ebor Mill, Haworth (**A2**), and Victoria Mills, Elland (**A12**, Figure 12.3: A377), where the 'open' privies were located on an axis with the main walkway through the main working areas of the mill.

The evidence of water closets therefore supports an interpretation of space within the mill being a controlled environment, which supported hierarchical labour relations. This is interesting for it suggests an inherent tension between concessions to improving working conditions, whilst at the same time ensuring effective supervision and control over the workforce. Furthermore, it provides compelling evidence of the recognition, on the part of the industrialist, that the factory was not only a *locale* for production but also a *locale* for the coming together of large numbers of workers and therefore a possible location for the expression of worker discontent or attempts to evade work. The privy is one of the few spaces within the complex in which workers could potentially evade supervision. However, the archaeological and supporting evidence from oral history from Yorkshire suggests that extreme efforts were made to avoid such action on the part of workers, such as half-length doors and the provision of only a single privy for each main working area. In this way, the spatial form of the factory allowed the imposition of effective control over workers and reflected the hierarchical, supervised nature of the workforce. Furthermore, it is clear that the hierarchy of the labour force and the rigid element of supervision were clearly understood, if not liked, by members of the workforce. It may therefore be suggested that much of this understanding, this individual and collective *habitus* about life as a factory worker, was structured by the physical structure of the mill itself.

Furthermore, the extent to which the actions of workers were controlled is also apparent in the amount of time allowed for breaks. At most mills it was usual for breakfast to be taken at the mill and then work to commence. Furthermore, at most sites, lunch and tea were taken at machinery (**A0085**, B86-7; **A0184**, B95). At a few sites canteens were provided, as at Frostholme Mill, Todmorden and Walsden (**A10**, Figure 10.3: A322), Park View Mills, North Bierley (**A11**, Figure 11.2: A343), and Ardsley Mills, East

Ardsley (**A9**, Figure 9.3: A294), and these were usually located immediately adjacent to the main staircase, thus limiting potential movement between the canteen and main working areas. At Saltaire Mills, Saltaire (**A8**), the canteen was housed on the opposite side of Victoria Road to the mill complex, but a tunnel immediately adjacent to the mill gate provided direct access without the need for any worker to stray in to the town (Plate 90).

Plate 90 *There was direct access from the mill yard at Saltaire Mills, Saltaire, to the mill canteen via the tunnel on the right*

6.3 REGIONALISATION OF THE *LOCALE*: SOCIAL IMPLICATIONS

The spatial evidence from the Yorkshire textile mill allows something to be said about the regionalisation of the factory as a *locale* for labour relations. Justified gamma maps of a number of different sites show a remarkable consistency in the relationship of certain spaces within the mill to each other and, in particular, allow two clear areas within the mill to be defined. This definition is based on the different characteristics of the spaces within the complex. First, in the shallower parts of the complex (usually within two spatial steps of the outside space) we find spaces that characteristically have more than one neighbour and, in terms of their RA value, are integral to movement about the complex as a whole. These spaces are best considered as thoroughfares and direction through them is highly directed from one space to another (Hanson 1998). In terms of the Yorkshire textile mill these spaces can be identified as mill yards and staircase towers.

Second, there are terminal spaces, which normally occupy the deeper parts of the complex. These tend to be the main working spaces, water closets or small offices. In some Yorkshire textile mills, the main working areas themselves provide access to additional spaces, such as water closets, but these do not act as a thoroughfare in the same way as staircase towers or mill yards lower in the complex, which, by virtue of their highly integrated character, are central to overall movement within the building.

This degree of zonation, as at Old Lane Mill, Northowram (**A4**, Figure 4.5: A156) (Plate 91), is of particular interest for a number of reasons. First, it supports the generic interpretation of the factory as a formally controlling structure in terms of human movement and interaction.

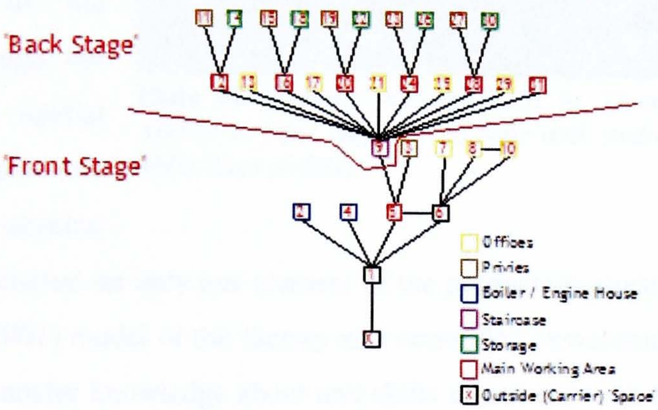

Plate 91 *Gamma map of Old Lane Mill, Northowram, split into 'front-' and 'back stage' zones*

The spaces in the lower parts of the complex inherently facilitate movement to those deeper spaces where production occurs. Furthermore, those thoroughfares lead to a high degree of segregation of spaces and people within the deeper parts of the complex, resulting in a tree-like shape.

Second, it reveals that the workforce occupied some of the deepest parts of the complex and therefore their movement away from the production process to the outside world was controlled, involving movement through other spaces. This was a powerful way of enforcing the separation of the workplace from the domestic setting, in both a formal and intuitive way.

Third, it provides compelling evidence supporting microeconomic interpretations of the factory system. The segregation of members of the workforce according to their individual skills and the part of the production process for which they had a specific responsibility is particularly suited to microeconomic interpretations. It is clear from oral history (**A0004**, B12; **A0006**, B29; **A0042**, B74-B75) that apprenticeships were served on the workfloor and that learning was undertaken by rote (**A0004**, B14). Since interaction between different parts of the workforce was limited through the segregation enforced by the spatial form of the mill, the apprentice was located within a specific working environment with attention focussed on only one element of the production process. This parallels McDermott's (2001) model of the factory as a controlled environment within which it was easy to transfer knowledge about and skills associated with the production process through observation and emulation, a fact which ultimately made the factory system preferential to more dispersed forms of manufacture.

Plate 92 *Workers' housing built by Thomas Ambler & Sons. adjacent to their mill, Ardsley Mills, East Ardsley*

Furthermore, the enclosed nature of the mill site as a whole restricted the transfer of knowledge about the production process away from the mill site. Menuge (1993) has suggested that the austerity of Arkwright's Cromford Mill, Derbyshire, with an absence of ground-floor windows and high perimeter walls, was a reflection of the desire to control access to his inventions and to protect against mill-wreckers. Such considerations were particularly important at early sites, but it seems that the resulting spatial enclosure persisted throughout the age of mill building in Yorkshire. The desire to control access to the production process may also be reflected in the increasing provision of worker housing by the industrialist. While the rapid construction of urban housing during the industrial revolution was the result of cheap speculative build (see, for instance Daunton 1983), many industrialists also provided housing for their workers, either in small concentrations, as at Aireworth Mills, Keighley (**A1**, Figure 1.3: A9), Gibson Mill, Wadsworth (**A3**, Figure 3.2: A99), and Ardsley Mills, East Ardsley (**A9**) (Plate 92), or, and more unusually, in the form of model worker settlements, such as

Saltaire (Saltaire Mills, Saltaire (**A8**)(see, for instance, Caffyn 1986). Traditionally, such gestures have been interpreted as philanthropy, but such generosity was clearly double-edged. Not only did it ensure a workforce located close to the site of production, it also allowed the exertion of an element of control over workers outside of the workplace. In particular, it tied the life of the worker to the factory for they were dependent on work for their living and their home. This deterred (or prevented) many workers from switching jobs between mills and therefore limited the transfer of knowledge about the firm and its products to competitors, as well as ensuring that time was not expended training workers who then left to work at other sites. This must have been a particular concern for manufacturers as oral history indicates that workers tended to move freely between mills in search of better wages and promotion (**A0001**, B3; **A0004**, B10; **A0035**, B49).

Microeconomic accounts of the factory also emphasise the importance of teamwork which has implications for labour relations since it requires some element of a hierarchy. The spatial form of the mill has already been shown to support a hierarchical labour force and these hierarchies existed within each work floor, supported by the evidence of overlooker's offices being placed adjacent to each principal working area. Furthermore, there was a degree of hierarchy across the site, with, for instance, management and administrative staff in office suites that were spatially distinct from the main working areas in the mill. Oral history (**A0004**, B12) indicates that apprentices would usually stay within the same part of the production process and progress through the ranks of the workforce with those specific skills. Thus, an apprentice weaver remained a weaver for life and there were few benefits in retraining. The picture is one of groups of workers who inhabited set parts of the mill and were committed to learning and operating a specific set of skills and knowledge about a particular element of the production process. One worker in an oral history interview remarked that he had not really appreciated the existence of other workers in other departments because his working life was restricted solely to the dyehouse, and he felt that it was the flow of production that linked workers rather than physical interaction. In particular, he recalled the team atmosphere in the dyehouse - 'I remember it as one of the best places I've ever worked at, because they seemed to be a team of people that were thrown together and they just hit off so well' (**A0004**, B18).

The idea that the factory engendered team working is of interest to our understanding of the mill as *locale* for the coming together of workers. It is clear, however, that although workers were encouraged to work as a team, the element of supervision was never relaxed to the extent it compromised the production process. In the first place, the spatial form of the mill allowed effective supervision. Second, within the labour force that hierarchy and its implications was clearly understood – one former overlooker remarked during an oral history interview that 'you were king in your own room' (**A0042**, B77) whilst a former winder remarked that the overlooker 'was just a grumpy person…you hated it when you had to fetch him over to your machine. But that's what he was there for, as well as keeping an eye on everyone, he had to keep up to the machines' (**A0184**, B96-B97) and a former spinner recalled that the overlooker was 'awkward - an awkward fellow to work with' (**A0006**, B30) The lack of any archaeological evidence to suggest the personalisation of the factory environment by workers during the industrial revolution and no evidence, such as graffiti, expressing worker discontent, would seem to imply that factory remained a highly controlled and structured environment. No doubt there existed a reflexive relationship between the authoritarian materiality of the mill and an existing understanding of 'how to go on' in the factory, which in the first place was probably largely structured by the mill as physical structure as it embodied a system of production which, prior to the industrial revolution, had no precedent in the textile industries.

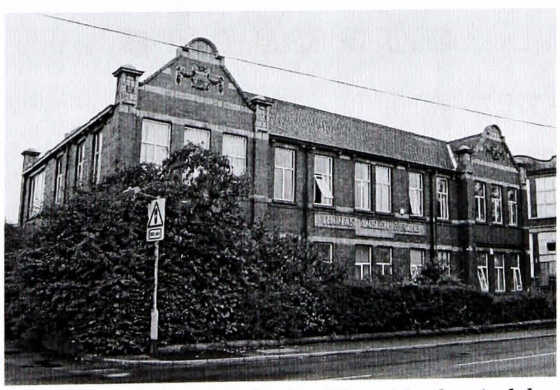

Plate 93 *The detached office block, Ardsley Mills, East Ardsley*

The zoning of the Yorkshire textile mill into different areas according to different jobs is most noticeable at large-scale integrated sites. Here, the distinction between different elements of the workforce and the production process can literally be mapped on to both the ground plan and spatial map of the site. However, one of the clearest distinctions is seen between administrative jobs and those directly associated with the production of textiles. The emergence of suites of administrative offices at the mill site is largely a mid-nineteenth century phenomenon associated with integrated sites, although some provision for offices is known at earlier sites such as Old Lane Mill, Northowram (**A4**, Figure 4.2: A137). Administrative offices were typically accommodated at the mill site in two main ways. Some were detached structures, like that at Ardsley Mills, East Ardsley (**A9**, Figure 9.1: A288)(Plate 93), and were often positioned close to the main entrance of the mill site. At Saltaire Mills, Saltaire (**A8**, Figure 8.1: A266), the detached office block (Plate 94) is placed on the main public axis to the mill site but is distinct from the route adopted by workers approaching the mill site. Alternatively, suites of offices could be accommodated within other mill buildings, as was the case at Frostholme Mill, Todmorden and Walsden (**A10**), Pecket Well Shed, Wadsworth (**A7**, Figure 7.3: A243), and Ardsley Mills, East Ardsley (**A9**, Figure 9.3: A294; Figure 9.5: A307)(Plate 95). However, despite sharing a physical relationship with

Plate 94 *Attached office block fronting Victoria Roads at Saltaire Mills, Saltaire*

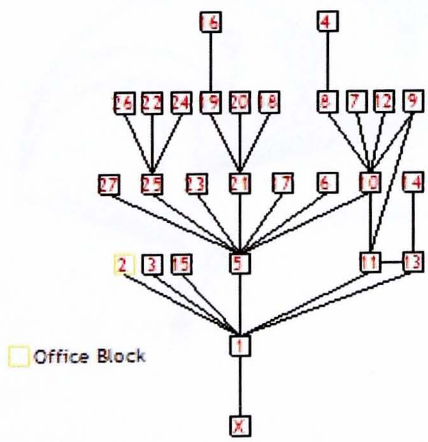

Plate 95 *The detached office block at Ardsley Mills (Plate 96) occupies an isolated part of the spatial complex of the mill*

other parts of the mill complex, non-detached office suites were nonetheless spatially distinctive. At Park View Mills, North Bierley (**A11**, Figure 11.2: A343; Figure 11.5: A361) the offices not only had their own entrance, distinct from the workers entrance, but spatially the office suite was separate from the rest of the complex with only one link between the offices and the main working areas of the mill (Plate 96). This distinct spatial configuration is all the more obvious if the gamma map is redrawn from the point of office staff using the mill (Plate 97) in which case the main working areas of the mill directly associated with the production of textiles are located in the deepest parts of the complex as a opposed to those spaces with an administrative function located in the shallower areas.

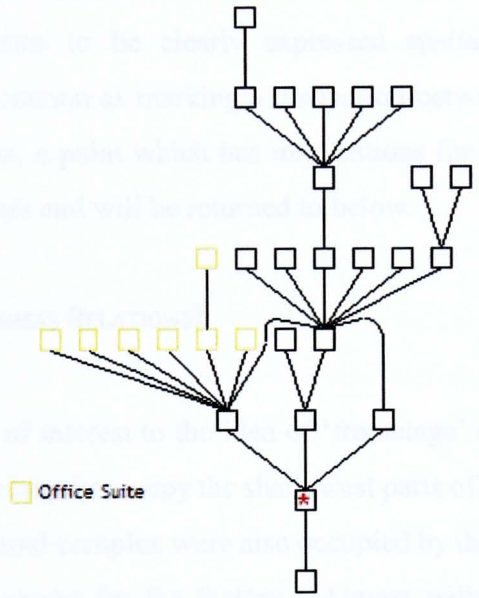

Plate 96 *Distinct spatial character of office suite, Park View Mills, North Bierley*

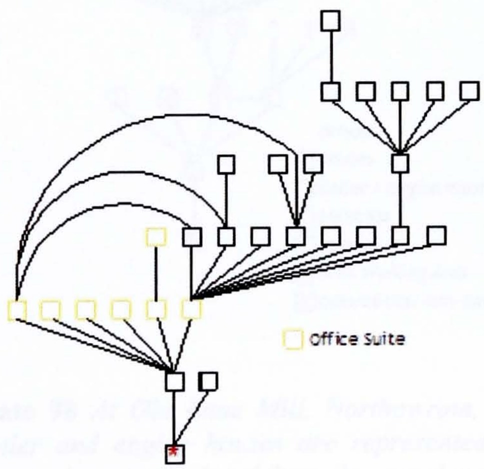

Plate 97 *Gamma map of Park View Mills, North Bierley, redrawn showing movement around the mill from the office suite*

This further example of zonation within the mill provides additional information about the segregation of workers. However, it is clear that the distinction between administrative staff and other workers at the site was not merely a reflection of job description. Oral history shows that office staff were considered higher in the workforce than spinners, weavers, winders etc (**A0062**). This implied hierarchy in labour relations seems to be clearly expressed spatially. Furthermore, we may see this element of zonation as marking a distinction between 'clean' and 'dirty' areas of the mill complex, a point which has implications for the understanding of the mill as business premises and will be returned to below.

6.4 REGIONALISATION OF THE *LOCALE*: BUSINESS RELATIONS?

The apparent zonation within the factory is of interest to the idea of 'frontstage' and 'backstage' spaces. Although thoroughfares largely occupy the shallowest parts of the complex, it is clear that these parts of the spatial complex were also occupied by those spaces associated with the production of power for the factory. Almost without exception, wheelhouses, and in particular, engine and boiler houses, are expressed on gamma maps as terminal spaces with direct access from the mill yard alone, a typical example being Old Land Mill, Northowram (**A4**, Figure 4.5: A156) (Plate 98). This has a practical explanation (see Chapter Five), not least because of the need to easily deliver coal and the risk of fire. However, it also had a social logic, which appears to have worked in two main ways.

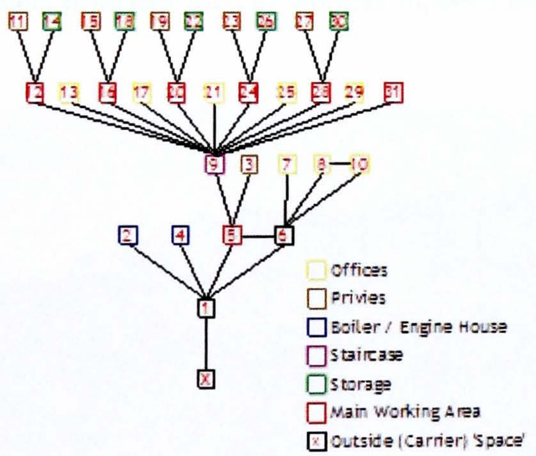

Plate 98 *At Old Lane Mill, Northowram, the boiler and engine houses are represented as terminal spaces isolated from the complex as a whole*

On the one hand, it provides evidence for the segregation of different parts of the workforce. Spatially, it is clear that there was a tendency for the engine and boiler house to be distinct from the rest of the complex and where there was some of direct access between these elements of the mill and the main working areas it was apparently highly controlled. At Queen Street Mill, Burnley, the mill rules (Lancashire County Council 1999) dictate that even the company director and mill owner was required to knock and await permission to enter the engine house. This reveals something of the specialist jobs within the mill workforce and access to different parts of the mill by different members of the workforce.

Alternatively, it also appears to reflect the role of mills as business premises in much the same way as the development of administrative office blocks. It was suggested above that the location of office blocks in the shallowest parts of the mill complex reflects a distinction between 'clean' and 'dirty' areas in the mill complex. This may be translated into an understanding those areas of the mill to which visitors were admitted or had access as opposed to those areas inhabited only by workers. The office block and its spatial disposition within the mill complex is therefore an obvious example of 'clean', 'public' and 'frontstage' area within the factory and the fact that more often than not they had their own entrance which was distinct from that used by workers supports the idea of their use by visitors. This is also supported, as we shall see later (Chapter Seven), by the formal evidence, which indicates that the office block was externally and internally subject to specific architectural embellishment setting it apart from the rest of the mill site. This is clearest at Ardsley Mills, East Ardsley (**A9**), where the mild classical style of the main mill concrete-framed mill contrasts markedly with the red brick, Jacobean style detached office block (Plates 93 and 99).

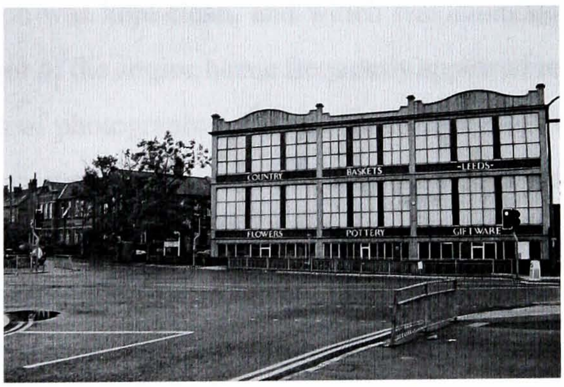

Plate 99 *The Jacobean-styled, red brick office block at Ardsley Mills, East Ardsley (see Plate 93) contrasts with the more rational style of the main mill building*

However, though they may be located within a similar position within the mill complex, how do engine and boiler houses fit in to the pattern of 'clean' and 'public' spaces? In terms of the boiler house, it would appear that it does not and that its position in the shallowest parts of the complex purely reflect the need for easy access and, in where possible, its location close to the engine house to which it supplied steam. The engine house, however, does not seem to have been considered a 'dirty' place. This is not only indicated by its place in the shallow parts of spatial complexes at textile mills, but also in the formal evidence and from documentary evidence. The formal evidence, more of which in Chapter Seven, shows that the interior of engine houses were subject to architectural embellishment, which in some cases could include elaborate plaster ceilings, panelling, glazed bricks as well as deliberate embellishment of parts of the engine itself, such as beam floors and flywheels (Plate 100). This suggests a space, which was kept clean, and which was intended should be viewed. Furthermore, the interior of the engine house frequently appeared in publicity photographs for mills. A series of photographs taken for such a purpose at Ardsley Mills, East Ardsley (**A9**), and annotated with the note that the mill should not be portrayed as 'dark or satanic!', included a number of shots of the engine house, rope race and engineers. The implications of these issues will be explored further in Chapter Seven but suffice to say here the spatial and formal evidence would indicate that engine house was one area of the mill, in conjunction with suites of administrative offices, that were visited and therefore were used as an expression of the mill and the company that operated it within an increasingly competitive business environment.

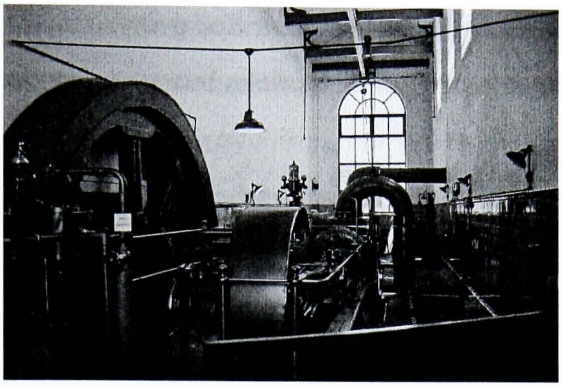

Plate 100 *Interior view of the engine house, Queen Street Mill, Burnley, showing use of an ornamental window and glazed brickwork*

This evidence suggests that the mill site also played an important role in business relations and that the spatial form of the mill dictated interaction between the business client, visitors, administrative staff, the mill owner and the greater part of the workforce.

We may therefore add business relations to our existing understanding of the material mechanisms through which a number of labour and social relations were structured at the mill site.

CHAPTER SEVEN
THE TEXTILE MILL - MEANINGFUL ARCHITECTURE

> '*In many instances the [industrial] buildings simple functional character is partly overlaid, but not disguised, by embellishments in a Georgian style such as it was thought proper at the time to give them*' (Richards 1958, 19)

Having considered the purely spatial aspects of the form of the textile mill, this chapter will be concerned with the exploration of the more qualitative and aesthetics aspects of factory design. By definition, architecture does not simply have a spatial character; it also has a distinct visual dimension. Indeed, if we recall Frankl (1968) then we see that the formal characteristics of buildings have three components – the geometry of space, mass and surface techniques and the effects of light, colour and other optical phenomena. Therefore, the way we experience buildings relates to the way we use them, their form, their structure and their aesthetics. This constitutes the reality of our physical experience of the built environment, but buildings not only have an existence in reality, they also have a metaphorical existence (Conway and Roenisch 2004, 22). Consequently, our use of the term 'function', in the context of the built environment, must take into account the complexity and variety of the subject matter involved and, crucially, the psychological associations connected with it (Rosenau 1970, 136). Because architectural form, decoration and embellishment reflects a conscious choice on the part of the patron, owner, architect or builder, those psychological and metaphorical associations can be seen as overt statements about those individuals and the building that they chose to build. Of particular interest here are those statements made through aesthetic aspects of factory architecture that have meaning in the realm of social relations.

This is an issue that demands careful qualification. Our understanding that the qualitative aspects of architecture have meaning in the realm of social relations is based on the belief that we not only physically interact with the built environment but also recognise the existence of and respond to a variety of symbolic metaphors and messages integral to it. Thus, we not only respond to the space enclosed and organized by buildings but also react to and are affected by symbolic representations which construct reality in particular ways. Those representations will normally relate to a dominant institutional discourse which reflects a certain kind of power and status responsible for a particular choice of architecture (stylistic and formally) and a certain kind of power enacted by those buildings (Markus and Cameron 2002, 15-16). That power extends into the disposition of space, the stylistic qualities of a building, and the environment created in and around the building through the choice of stylistic motifs, embellishments, fixtures and fittings (Markus 1993b, 18). Put another way, if we accept this position we also accept that the choice of architecture style for a building can be used as a powerful tool in the creation of social hierarchies and power structures because we accept that the builder or patron has made a conscious choice to build in a certain stylistic or formal way in order to create and transmit specific social statements (Locock 1994, 1).

Of course, the concept that factory buildings have an aesthetic quality and are socially meaningful stands in stark contrast to orthodox studies of industrial architecture (*cf.* Holmes 1935; Richards 1958; Jones 1985; Davey 1994). However, the idea that industrial architecture directly reflects its practical function as a place of manufacture is not borne out by the archaeological evidence from the industrial revolution factory. In fact, the physical evidence from the Yorkshire textile industry suggests that between *c.*1780 and 1930 the use of a decorative style of architecture actually defined the textile mill as a distinct building type, and that the period was one of considerable experimentation with the application of Classical styles in the context of the factory building. This evidence fits a more general pattern - nineteenth century architecture was characterised by the rise of new building types suited to an industrial era during which patrons and architects went in deliberate quest of architectural innovation (Mignot 1983, 12).

Furthermore, one of the major changes brought about by the industrial revolution was social redefinition, in particular the emergence of new social groups or 'classes'. In fact, so interwoven with the industrial revolution is the concept of social redefinition that it has been argued the concept of social 'class' with all its attendant terminology was a product of the large-scale economic and social changes of the late eighteenth and early nineteenth centuries (Briggs 1985). A major feature of the period was the emergence of a new capitalist class, comprising the new industrialists and entrepreneurs, and the working classes. The co-existence of these social groups and their relationship with each other and, in particular, the gentry, has been the subject of prolonged historical debate (for some of the major works in the field see Hoskins 2000; Thompson 1981; Hobsbawn 1965; Morris 1979; Musson 1972; Neale 1972; Perkin 1969; Jones and Mingay 1967). These inter-relationships are germane to the idea of meaningful architecture. In the previous chapter, it was demonstrated that the spatial arrangement of Yorkshire textile mills reflected the desire of the entrepreneur to control the workforce, to establish hierarchical labour relations and to facilitate business. It may be expected that similar power structures, hierarchies and social relations to have been structured through the qualitative aspects of mill architecture. Of particular relevance is the concept of Closure Theory and the ways in which individuals within society attempt to bolster their position through acting as a group. In this context, the choice of architecture is socially motivated and designed to create and transmit specific social messages and it promises that through the study of architecture we can begin to move towards an understanding of the psychology of the capitalist classes, in particular the dominant ideals of that class during the industrial revolution, something that we may term 'Enlightenment Thinking'. Here, then, are explicit parallels with Bourdieu's concept of the collective *habitus* (see Chapter 3).

This raises a number of important issues and demands a close examination of the use of architecture in the textile industries. A number of specific questions require answers. Why did industrialists choose to embellish their buildings, as the cost of incorporating decorative motifs required additional investment in buildings that at their most basic provided shelter for the processes of production? Why did the Neo-Classical style, in particular Italianate Classicism predominate within the textile industries? What 'function' did the use of this architectural style fulfil if it did not directly relate to the production of textiles in any technological or practical capacity? And, in what ways does the formal architecture evidence from the textile industries relate to the purely spatial evidence observed in Chapter Six?

These issues are complex and it is therefore useful to begin by outlining in brief the development of architecture in the context of the Yorkshire textile industries. By doing so, we may establish a baseline against which it is easier to consider existing interpretations of factory architecture and to suggest new ones based on archaeological evidence.

7.1 THE TEXTILE MILL - ARCHITECTURAL OUTLINE, C. 1780-1930

The first generation of mill buildings in Yorkshire, as we saw in Chapter Five, were multi-storeyed buildings, rectangular on plan and varying in size from between several hundred metres of working space to the largest providing over 2,000 square metres (Giles and Goodall 1992, 22-23). Archaeological studies of textile mills in Greater Manchester and East Cheshire have revealed similar statistics for earlier mills in other geographical locations, suggesting a degree of homogeneity in earlier mill construction in the North of England and between the different sectors of the textile industries (Williams and Farnie 1992; Calladine and Fricker 1993) .

Giles and Goodall (1992, 23) argued that the majority of pre-1825 multi-storeyed mills in Yorkshire displayed little architectural embellishment. Most were built with local materials, generally rubble in the Pennine foothills and brick elsewhere. Many of the details that they incorporated were taken from the local vernacular tradition. For instance, many early mills built in the late eighteenth and early nineteenth centuries employed doors and windows with ashlar surrounds, as at Gibson Mill, Wadsworth (**A3**), built *c.*1800 (Plate 101) and the 1819 worsted spinning mill at Ebor Mill, Haworth (**A2**). During the course of the nineteenth century these vernacular features were gradually supplanted with rectangular stone lintels and sills, and, more commonly, brick segmental-headed openings, as at Pecket Well Shed, Wadsworth (**A7**), built 1858, and at Victoria Mills, Elland (**A12**), built 1898 (Plate 102).

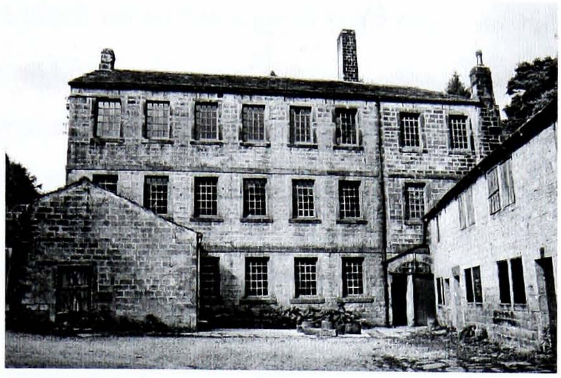

Plate 101 *Gibson Mill, Wadsworth: built c.1800 in a largely vernacular style*

Plate 102 *Victoria Mills, Elland, is built of local sandstone with red-brick dressings*

However, whilst early Yorkshire textile mills are characterised by their relatively simple architectural style it is not true that all early mills offered few concessions to decoration. Giles and Goodall (1992, 24) have suggested that where such detailing occurred it was usually restricted to the largest mills of the period. Certainly, it is true that the most obvious use of architectural embellishment is seen in the larger early mills. Old Lane Mill, Northowram (**A4**), built *c.*1824-5 (Plate 103), is notable not only for its experimental design and its sheer scale, but also because of the use of rusticated ashlar surrounds to the engine house window, main doorways, loading passage and the arches fronting the

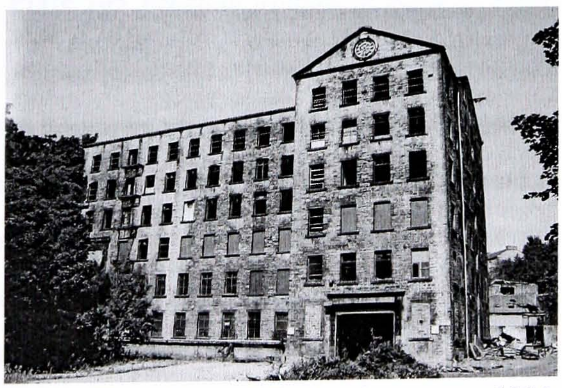

Plate 103 *Old Lane Mill, Northowram, c. 1824-5, incorporates a number of Palladian motifs*

boiler house, a large pediment including a clock set within a moulded ashlar surround and a moulded eaves cornice. Other common Classically-inspired details used on large-scale early mills included the breaking-forward of the central bays on the main facade, at as Sowerby Bridge Mills, Warley (**BFO8280**), as well as Palladian and oculus windows, as at Marshall's Mill, Holbeck (**BFO41529**).

It is clear, however, from the archaeological evidence that the use of Classical motifs in early mills was not restricted to the largest mills. Rather, the use of some degree of embellishment was relatively common across mills of all branches of the industry and of all sizes. In fact, few mills did not incorporate some degree of embellishment, although inevitably some were built without decoration, such as the 1819 phase of Ebor Mill, Haworth (**A2**), which is devoid of any detailing but for paired gutter brackets and sill bands (Plate 104). However, at other sites the use of Classical motifs is explicit. At Firths Mill, Lockwood, Huddersfield (**A5**), a medium-sized mill built between 1820 and 1830, Venetian windows are used in the gables to light the attic working space (Plate 105); at Aireworth Mills, Keighley (**A1**), a bell cote styled as a cupola and a clock within a moulded surround were incorporated in to the rebuilt mill of 1808 and, at Gibson Mill, Wadsworth (**A3**), a small rural spinning mill built *c.*1800, a horizontal tripartite division, reminiscent of Palladian proportions, is contrived through the use of prominent stringcourses.

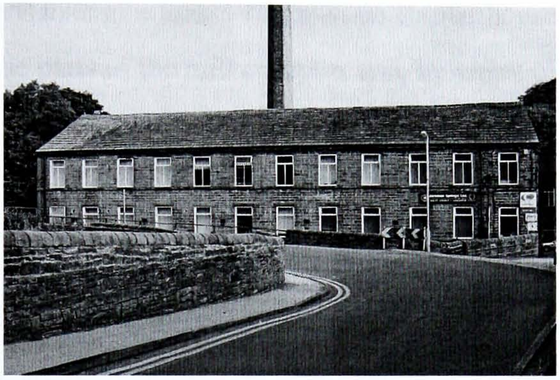

Plate 104 *Ebor Mill, Haworth, is devoid of any significant architectural embellishment*

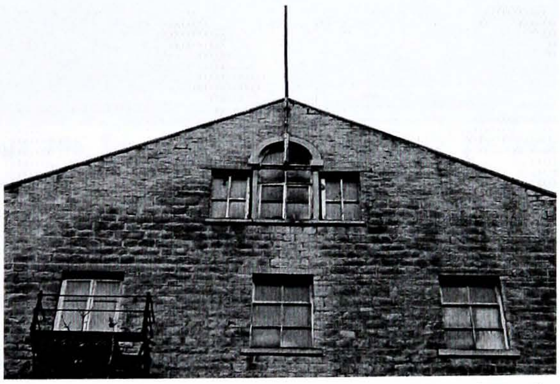

Plate 105 *Venetian window in gable of Firths Mill, c.1830*

about the appalling conditions in factories and workers' communities by social commentators during the period (Hudson 1992, 9-13).

Saltaire Mills, Saltaire (**A8**), the result of a collaborative effort between Sir Titus Salt, the eminent mill engineer William Fairbairn and the architects Lockwood and Mawson of Bradford, may be justly considered something of an icon of its age and established common practice in mill design. Of course, many of the motifs used at Saltaire had been used at other sites, but at Saltaire Mills can be seen the overt the use of Italianate architecture in the textile mill and the physical embodiment of Fairbairn's 'improved' mill architecture, a treatise on which he published in 1863 (Plate 107). The vast mill incorporates pavilion-styled towers, pilasters, a rusticated basement and quoins throughout, round-headed windows, curved and broken pediments and chimney with rusticated plinth and campanile-styled cresting. Saltaire Mills were widely publicised and admired during the industrial revolution and undoubtedly created an architectural template for other mill builders and industrial architects. The tenacity and popularity of the Italianate style is eloquently illustrated in the built environment of mid to late nineteenth century Bradford. Significantly, when Sir Titus Salt's main local competitor, Samuel Lister, chose to enlarge his Manningham Mills, Manningham (**BFO62439**), in 1871-3, he did so using an Italianate style. Lister chose to rival the Saltaire complex through scale, particularly that of the campanile-styled chimney, rather than through the use of a different architectural style. This strongly suggests that the Italianate style was *the* recognised choice for mill buildings by this time.

Plate 107 *Fairbairn's Italianate masterpiece - Saltaire Mills, Saltaire*

The development of the layout of the mill from the early nineteenth century led to a number of new features of mill architecture and the many of features exhibited at

Saltaire Mills, Saltaire (**A8**), were readily translated and abstracted for use at other sites. The introduction of steam power and the treatment of engine and boiler houses have already been commented on and were elaborated upon during the mid nineteenth century. In particular, the introduction of the horizontal engine and the rope drive stimulated increasingly ornate engine house interiors, including panelled walls, elaborately carved friezes and the use of decorative tiles and glazed bricks, and there was also increased attention paid to the appearance of features like columns. The increased use of projecting stair and privy towers also afforded an opportunity for new architectural designs. It was common for attention to be drawn to towers. At Saltaire Mills, Saltaire (**A8**), the privy towers are decorated with pilasters and the central towers surmounted by pavilions, whilst at other sites towers incorporated decorative friezes and inscribed plaques. Classical motifs like rustication, were also applied, commonly to taking-in doors, as at Britannia Mills, Lockwood, Huddersfield (**A5**)(Plate 108), whilst principal doorways were often elaborated through the use of distinctive moulded stone hoods and shaped lintels, as at Pecket Well Shed, Wadsworth (**A7**). Furthermore, many mid to late nineteenth century chimneys received increased decoration, notably concentrating on the plinths and the over-sailing courses of the cresting (Plate 109). Thus the chimney, in many instances, was an abstracted representation of the Classical column or, as at Manningham Mills, Bradford (**BFO62439**) and the 1870 'New Mill',

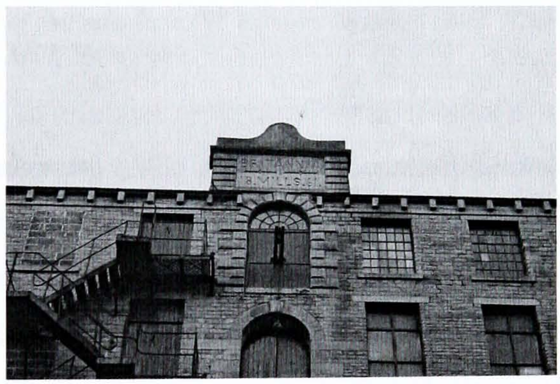

Plate 108 *Rusticated surrounds to taking-in doors, shaped pediment and inscription, Britannia Mill, Lockwood, c.1861*

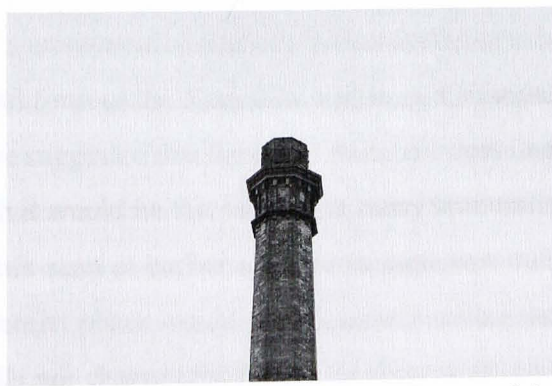

Plate 109 *Decorative cresting at the top of the late 19th century chimney at Ebor Mill, Haworth*

at Saltaire (**BFO41553**), was designed to look like an Italianate campanile. Significantly, the mill chimney was one of the most visible aspects of the mill complex and it is therefore unsurprising that it was often the part of the mill to which particular architectural attention was given.

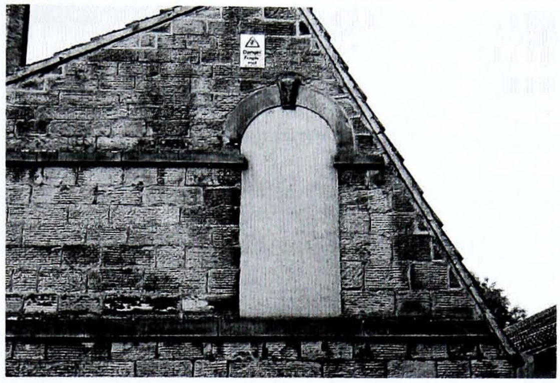

Plate 110 *Round-headed openings in the gables of the mid-late 19th century weaving shed, Ebor Mill, Haworth*

It is noticeable that as many textile producing sites in Yorkshire moved towards integrated working, the greatest attention was paid to the architectural treatment of multi-storeyed buildings, presumably because of their increased visibility. Sheds, by virtue of the reduced wall space in comparison multi-storeyed mills, tended to be given less ornate treatment, although the weaving shed at Pecket Well Shed, Wadsworth (**A7**), incorporated a round-headed rusticated loading door in its main faced whilst the *c.*1870-1880 weaving shed at Ebor Mill, Haworth (**A2**), has round-headed louvered openings with key blocks in the gables of the north-lit roof (Plate 110). Increased attention was also paid to the aesthetic appearance of office blocks; most especially at sites were detached office blocks were constructed. This is, perhaps, unsurprising as the office block represented the public and business interface of the company.

Between *c.*1880 and 1930 the architectural form of the Yorkshire textile mill changed little. Giles and Goodall (1992, 36-7) have suggested that the use of Italianate detailing became increasingly limited and although it would be fair to say that many later mills lacked the profuse use of Classical motifs seen at earlier sites, to suggest that mill building had entered a minimalist, Modernist phase would not accurately reflect the archaeological evidence. Many late mills are characterised by their sheer scale and developments in steel and re-enforced concrete structural engineering allowed mills of increasing size to be built. Also increasingly popular was the single-storey shed that was no longer confined solely to weaving. However, neither of these principal developments entirely brought about the end of the Classical tradition in mill building. At many sites, this may reflect the fact that later mill buildings were added in a sympathetic style to existing structures at the site. At Ebor Mill, Haworth (**A2**), a large mill, built in 1887, was built in a style sympathetic to a mid-nineteenth century weaving shed and engine house already existing at the site. Similarly, at Victoria Mills, Elland (**A12**), built in 1898, the new mills reflected the design of earlier mills on the site that had burnt down and their architecture is therefore reminiscent of the earlier structures at the site but was nonetheless deemed suitable in a late nineteenth century context.

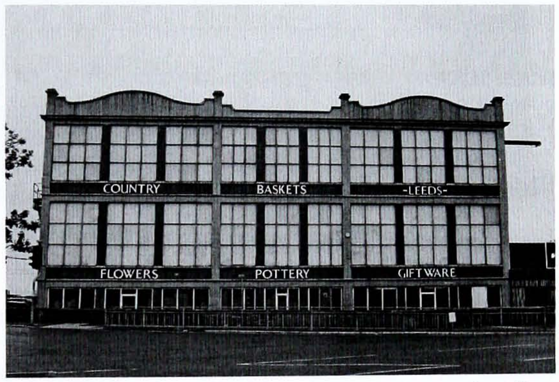

Plate 111 *The 'modern' concrete framed mill at Ardsley Mills, East Ardsley, incorporates gently curving parapets in a mild Classical style*

However, it is also clear that lingering Classicism was also a deliberate choice on the part of the mill builder and architect. At Frostholme Mill, Todmorden and Walsden (**A10**), the 1884-5 multi-storey block on the road frontage adopts a mild Classical form with gables contrived as a series of small pediments and rusticated openings and a parapet to the internal boiler house. Similarly, Ardsley Mills, East Ardsley (**A9**), built in 1912 on the basis of the latest reinforced concrete technology incorporates gently curving parapets and the concrete frame is left exposed, contrasting with the large expanses of glass and red brick in-fill and thus creating the effect of pilasters (Plate 111). Perhaps the most explicit example of the tenacity of Classicism in the tradition of mill building is at Park View Mills, North Bierley (**A11**, Figure 11.3: A347). Built in 1924-5 as an electric-powered, steel-framed single-storey weaving mill (with probably provision for spinning in the basement) Park View Mills incorporates the latest structural technology and principles

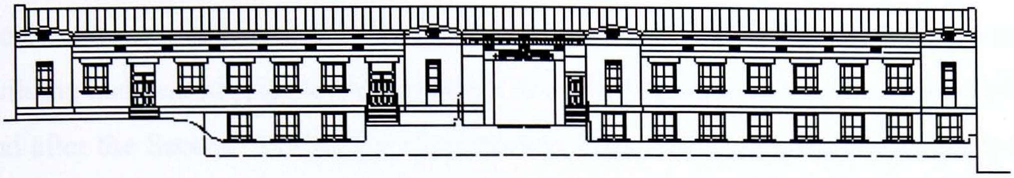

Plate 112 *North elevation, Park View Mills, North Bierley*

of modern mill design. However, the north elevation is contrived as a show facade in a classical style with pediments, bracketed cornice and a frieze of repeated trigyphs (Plates 112 and 113).

Plate 113 *Detail of decorative north facade at Park View Mills, North Bierley*

This 'lingering classicism' is interesting for on the one hand it reflects an obvious continuity with mill architecture in the past, establishing the classical (in particular, the Italianate style) as something of a 'house style' for the textile industries and as a defining characteristic of mills as a building type. However, and conversely, it also reflects a movement towards a more modernist style. Summerson (1963) recognised that the origins of the Modern Movement in architecture were grounded in a classical tradition and Richards (1958) saw an explicit relationship between the genesis of Modern forms and the functional tradition of industrial architecture. The extent to which the architectural evidence in Yorkshire can be seen to fit Summerson's or Richard's model is difficult to assess. Certainly some early twentieth century mills, such as Ardsley Mills, East Ardsley (**A9**), have a definite 'Modernist' character but elsewhere, as at Park View Mills, North Bierley (**A11**), a classical tradition persists. Furthermore, even at 'Modernist' sites like Ardsley Mills, the mill may have been minimalist in character but the adjacent office block was an essay in high Jacobean classicism, denoting that a classical style retained a potent presence at early twentieth century sites. It may well be case that true Modernist architecture was not applied to the Yorkshire textile mill as the age of traditional mill building had ceased prior to the explosion of a more minimalist style in the late 1920s and after the Second World War (Summerson 1963, 106; Benevolo 1971; Frampton 1992). In mill architecture, therefore, can be seen the longevity of a beloved classicism and the tentative exploration of a more Modernist style.

In summary, and on the basis of the archaeological from the Yorkshire cotton and worsted industries, the aesthetic form of the mill conformed to a largely classical style, dominated by Italianate embellishments. This tradition was dominant throughout the age of mill building, though the extent of its application varied between sites. Although other styles are represented within the Yorkshire textile industry, including the Gothic revival and the Byzantine, and in that one remarkable case of Marshal's Mill, Holbeck, Leeds (**BFO41529**), the Egyptian, these alternatives never found widespread application within the Yorkshire textile industry.

7.2 A CLASSICAL TRADITION: ORIGINS AND APPLICATIONS

The fact that considerable attention was clearly paid to the aesthetics of the Yorkshire textile mill raises a singularly important issue. It follows that the use of the decorative architecture in the context of the factory served no practical function, in terms of the production of textiles, and we must therefore seek an alternative explanation. The remainder of this chapter will therefore seek to address the theoretical propositions raised at the start of this chapter, namely that architecture is socially meaningful and was one form of material mechanism through which social relations were defined and new power structures created and maintained. It will be argued that the style of architecture for the Yorkshire textile mill was contrived for a wider audience and therefore, unlike the spatial qualities of the mill which 'looked in' on the mill complex, the more formal aspects of mill architecture 'looked out' and made social statements which were meaningful to a number of different groups. The architecture of the Yorkshire textile factory was principally authoritarian. As a physical entity within a wider landscape it defined relations between the industrialist and worker, the entrepreneur and the gentry, and the businessman and the client. It therefore had different meanings to a number of different audiences and therefore fulfilled a number of different social and economic roles on the part of the capitalist. Furthermore, the social significance attached to the form of the mill was dependent on time and space – the context of the mill is therefore all-important. Some meanings changed over time, some are only apparent in specific circumstances and others were developed as the age of mill building advanced.

In order to contemplate these issues and the social function of mill architecture it is necessary to ask a fundamental question: why was a Classical style chosen for the buildings of the textile industries? Only by establishing the origins and initial application of the classical style in the mill can we begin to unravel its social significance. Furthermore, it provides a vital starting point from which to explore changing associations and metaphors over time.

In the quest for the origins of the use of classical architecture, it is essential to recognise a number of different influences and precedents. Traditionally, the architectural style of the Yorkshire textile mill has been attributed to pre-industrial corn and fulling mills. Giles and Goodall (1992, 22-3) adopted a position suggesting that the earliest mills took their form from water powered mills as well as early warehouses leading to the typical multi-storeyed spinning mill. Certainly there are clear parallels between the first generation of textile factories and these pre-industrial structures, but the strongest analogy is in their plan, which largely reflects that other common feature: the use of waterpower. Equally, it is clear that early mills borrowed heavily from local architectural traditions (see above) and this synthesis of functional and vernacular attributes has led to early factories being described as 'sub-idiomatic structures' (Stratton and Trinder 1997, 51).

However, it is also clear that form of the mill also borrowed heavily from a number of proto-structures within the textile industries and, in particular, the aesthetic attributes of mill architecture seem to owe more to these proto-industrial buildings than they do to either vernacular or pre-industrial traditions. The influence of proto-industrial buildings upon the development of mill architecture is of particular interest for it implies that the architectural style of the mill was, at least partly, heavily influenced by building types that developed in response to organisational change within the textile industries rather than technological innovation.

In the first place, there is a clear parallel to be drawn between the overall appearance of the earliest textile mills and earlier loom and spinning shops. Independent loom and spinning workshops represent the gradual intensification of control over the production process by clothiers and the genesis of the shift of the place of work from the domestic setting. The independent loomshop is of particular interest for it represents a proto-industrial structure that was not reliant on the development of new technology. Between the late eighteenth and early nineteenth centuries an increasing number of shared loomshops were constructed across Yorkshire and were designed to house hand looms and were built on and off textile mill sites (Giles and Goodall 1992, 18-20). The fact that there is a close temporal relationship between the earliest spinning mills and these proto-industrial buildings makes it difficult to establish if one influences the form of the other. However, it is clear that the shared loomshop was a development from independent operations in cellars and attics of houses and represented a transitional stage between domestic-based weaving studios and the independent loomshop. Such a development is represented by the attached loomshops at the Rookery, Addingham (**BFO34366**). Furthermore, one of the earliest independent loomshops survives at Sowerby Bridge Mills, Warley (**BFO8280**), and was built shortly before 1792 (Plate 114). In this building, which predates the majority of

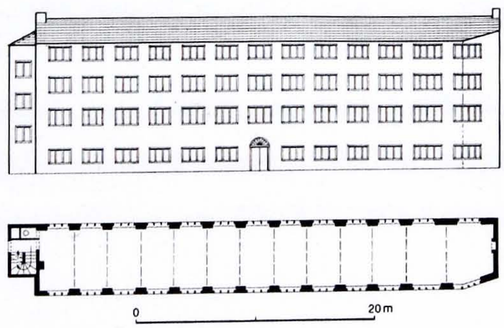

Plate 114 *The 1792 loomshop, Sowerby Bridge Mills, Warley*

early spinning mills, we can see a clear precedent for the appearance of the Yorkshire textile mill.

However, the close relationship between the form of the loomshop and early mills does not explain the application of a Classical style in the textile industries. For that stimulus we must stay with the clothier but look elsewhere. Pre-industrial textile production was based on the independent artisan manufacturer or the putting-out based upon domestic spinning and weaving for yeoman clothiers who delivered raw materials to workers and collected finished goods (Hudson 1992, 116). Central to both these pre-industrial systems was the market and from the sixteenth century Cloth Halls were erected within Yorkshire to provide a specific location for the sale of products (Linstrum 1978, 282). During the eighteenth century an increasing number of Cloth and Piece Halls were built in towns, reflecting the growth of the textile industry and invariably they were built in a classical style.

The Coloured or Mixed Cloth Hall at Leeds, built *c.*1780, was designed by John Moxon and consisted of a rectangular courtyard surrounded on three sides by single-storey brick buildings and incorporated a pedimented central section surmounted by a bell cupola. The Huddersfield Cloth Hall, built in 1766 (Plate 115), was elliptical in plan and the east facade, the main elevation facing the town, was of brick, pedimented with stone quoins and dressings and topped by a clock tower and bell cupola, whilst internally the hall had a central row of stone Tuscan columns (Crump and Ghorbal 1935; Linstrum 1978, 283-285).

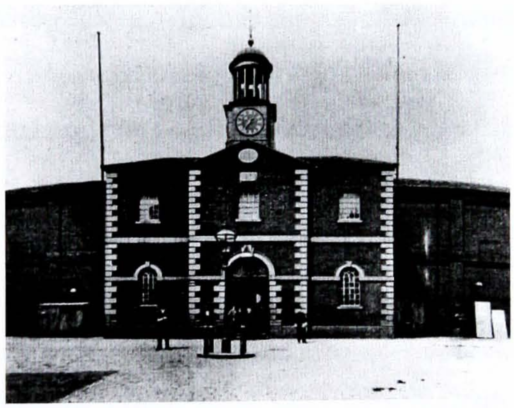
Plate 115 *Huddersfield Cloth Hall, c.1766*

However, perhaps the greatest Cloth Hall constructed for the Yorkshire textile industry was the Halifax Piece Hall. Built between 1775 and 1779, the Piece Hall stands as a

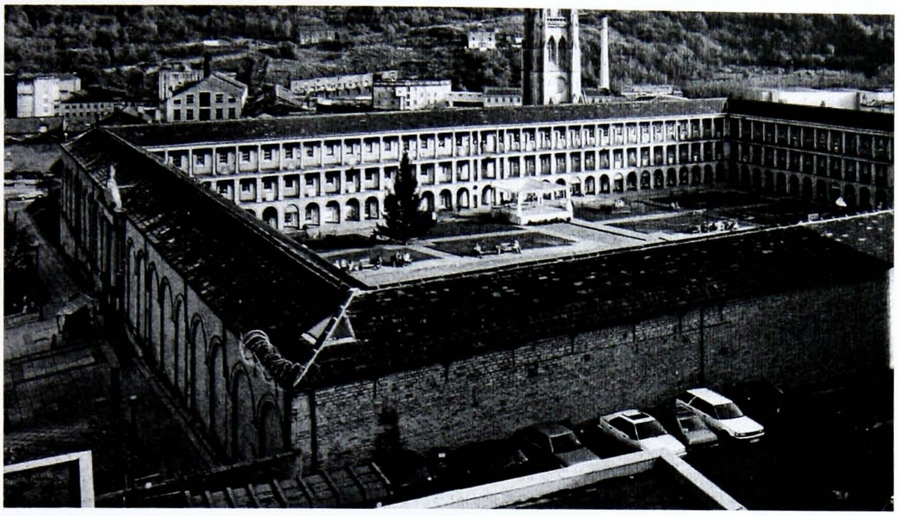

Plate 116 *Halifax Piece Hall, c.1775-1779 (Giles and Goodall 1992, 78)*

major monument to the eighteenth-century Yorkshire textile industry (Giles and Goodall 1992, 78; Plate 116). The 'hall' is arranged around a vast courtyard with a main entrance from the west through a pedimented archway surmounted by a cupola. Two storey ranges surround the courtyard with rooms opening of an open gallery. The gallery opens on to a Tuscan colonnade on the top storey, which is supported on square rusticated piers to the first and ground floors. Linstrum (1978, 288) said of the Halifax Piece Hall – 'it was conceived on a monumental scale and with an architectural quality greater than required by pure utility'.

The classical style of the Yorkshire Cloth Hall is of considerable interest to this discussion. It is in the Cloth Hall that we see some of the earliest uses of Classical architecture within the Yorkshire textile industries and as these halls were the only major buildings within the industry before the development of proto-industrial loomshops, spinning shops and then the mill proper, it is reasonable to suggest that their architectural style was appropriated from one icon of the industry, the Cloth Hall, to that other icon, the textile mill. Extending further back, the use of a Classical form for the Piece Hall may have been inspired by contemporary buildings arranged around a courtyard and there is a certain similarity between the stable blocks of Palladian country houses and the Cloth Halls of Yorkshire.

The symbolism of the Cloth Hall and its distinct form, in particular the use of Palladian detailing at its entrance, were readily appropriated for use on the mill. Furthermore, the Cloth Hall represented a *locale* for the coming together of a group of like-minded individuals, the clothiers and artisan producers who governed the pre- and proto-industrial textile industry. The Cloth Hall was therefore a place for the exchange of goods and ideas - it was a symbol of the industry and the people of that industry. We may therefore propose that the Cloth Hall provided a physical environment in which many of the fundamental industrial and economic ideas of the proto-industrial and fully industrialised textile industries were worked out by those directly involved. It is tempting, therefore, to also suggest that the architecture of the Cloth Hall, a classical Italianate idiom, became entrenched in the minds of those entrepreneurs and industrialists who met there and it was readily transferred to the buildings that they built, the factories and mills. In any case, it emphasises a close, and very important interrelationship between developments in the textile industry, business practices, the enlightenment thinking of the industrialist and classical architecture.

The form of the textile mill also probably followed the model of a number of famous early industrial buildings in England. Albion Mill, London, a corn mill built between 1783-6, employed an overtly Palladian style with a rusticated basement, slightly projecting wings and stylised Venetian windows (Markus 1993a, 270; Plate 117). At the time of its destruction by fire in 1791, it was one of the most renowned industrial buildings in Europe and therefore a likely prototype for later industrial buildings.

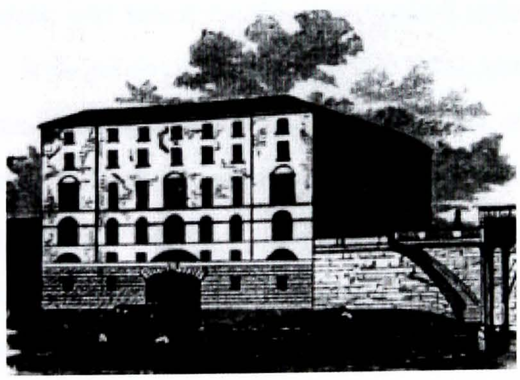

Plate 117 *Albion Mill, London, c.1783-6 (Markus 1993a, 270)*

However, there is one other early industrial building that stands out as a potential model for the later form of the textile mill. Lombe's Mill, Derby, a silk mill built 1717-19, was famous in its day and one of the first experiments in centralised, large-scale textile production (Plate 118). Architecturally, the mill was relatively plain but mild classical influences are discernible including arched openings at basement level and a decorative parapet hiding the roof structure (Calladine 1993; Markus 1993a, 263).

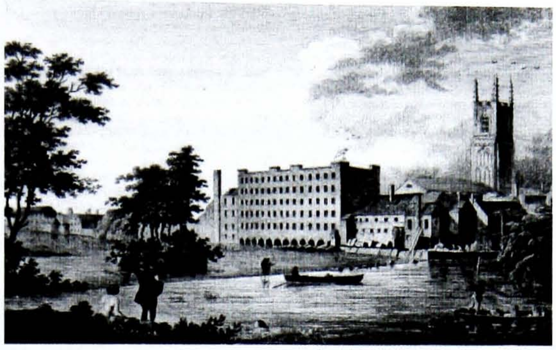

Plate 118 *Lombe's Mill, Derby, c.1717-19 (Markus 1993a, 263)*

As a model for later mills, particularly those innovative early mills built by Arkwright and Strutt further north in the Derwent Valley, the Derby Mill provides compelling evidence. However, the choice of Palladian architecture for even early industrial structures is not explained by its physical presence.

The origins of the use of the classical idiom in pre-, proto- and early industrial buildings are a clear reflection of contemporary eighteenth century taste. During the eighteenth century the 'rule of taste' of the upper classes was based on the Neoclassical style inspired by the Grand Tours and antiquity. It found expression at a board level, but most commonly within polite circles (Summerson 1983; Parrissien 1994). The use of polite architecture in the context of industrial buildings is interesting for the orthodox view of industrial architecture would not suggest a convergence of polite and utilitarian taste. However, the development of larger industrial buildings presented a significant problem in terms of the history of industrial architecture. In the first place the development of industry, even prior to the industrial revolution had brought about the emergence of new types of building, such as the proto-mill and Cloth Halls. It was perhaps unsurprising that the builders of these industrial edifices looked to other examples of large-scale building for inspiration. In particular, the form of the Cloth Hall, arranged around a central courtyard with a main entrance is particularly reminiscent of contemporary stable blocks.

There is also a further point to be made. Notwithstanding the obvious use of classical architecture in the Cloth Hall, the market place also served as an exchange for ideas. We may therefore argue that the development of an architectural style for the mill was also the product of a process of enculturation and emulation which had at its heart the transfer of ideas between clothiers and artisans at the Cloth Hall. Within this environment it is tempting to suggest that the latest technological developments and changes to industrial buildings were being discussed as well as the Cloth Hall itself providing a model. In summary, the Cloth Hall seems to have played a major role in the genesis of the classical style in the textile factory, both as model in its own right as a *locale* for the transfer of ideas, in particular the cementation of a close relationship between classical architecture and the textile industrialist in so much as this group clearly associated themselves with the Italianate style from an early date.

The idea of mill architecture emerging largely through interaction between those individuals at the heart of the proto-industrial organisation of the textile industry provides a model within which the emergence of the mill as a building type with a distinctive form and appearance is seen to have occurred in much the same way as technology developed during the period. Furthermore, the organisation of the textile industries prior to the industrial revolution, was characterised by lax control from guilds (Thornes 1981) and where restrictions on landownership were limited (Nevell and Walker 1998; 1999) – indeed, many of the areas in Yorkshire where industrialisation occurred first and on the greatest scale were some of the last parishes undergo Parliamentary enclosure (English 1985). This social and political environment therefore encouraged yeomen clothiers and other participants in the textile industries to seek more intensive forms of production, which ultimately led to the emergence of the textile mill.

The application of classical details to the Yorkshire textile mill not only reflects a degree of experimentation with how best to incorporate these embellishments on a new type of building, but also reveals something of the process underlying their use in the first place. Although relatively plain, the impression of the earliest mills is a general desire to incorporate polite motifs where possible. Thus, we find that Venetian windows were readily used in gables to light attics and rustication to demarcate basement stories and on door surrounds, but other motifs such as pilasters and porticos were harder, if not impossible, to use in the context of the factory. As the form of the mill developed, a number of new features such as stair towers and the steam plant provided the mill builder, and later the industrial architect, with a new palette. Thus the chimney became an abstracted column, the stair tower was embellished with a number of classical motifs ranging from rustication, pilasters, cartouches, pavilions, decorative parapets and roofs whilst attention was drawn to engine and boiler houses through the use of rusticated surrounds to windows and other openings.

The degree of experimentation is also evident inside the mill. In some early mills, notably the most experimental designs, and in some middle period mills, elements of the interior were embellished. The interior decoration of the engine house (as we shall see later) was not uncommon, nor was some element of embellishment on cast-iron columns, but other wise the interior of the mill was unadorned. However, at Old Lane Mill, Northowram (**A4**), built 1824-5, the form of the cast-iron roof trusses is relatively ornate, as are the tiebeams of the 1860 weaving shed at Frostholme Mill, Todmorden and Walsden (**A10**)(Plate 119). Comparable and later examples of this kind of decoration are relatively uncommon and this may reflect experimentation with incorporating interior decoration that was never widely adopted and is therefore restricted to early and middle period mills. This is most notable in the case of Saltaire Mills, Saltaire (**A8**), which was clearly designed as a 'show piece'. The roof at Saltaire Mills, widely acknowledged at the time of the mills opening in 1853 as the largest room in the world, and thus widely viewed and publicised, employs a plain style of roof trusses that which contrasts with the more ornate trusses seen at some earlier mills (Plate

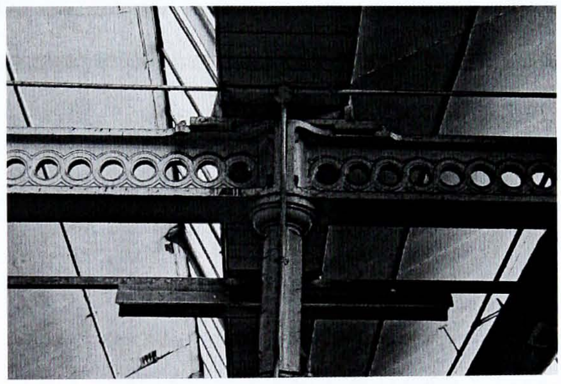

Plate 119 *Decorative tiebeams in the c.1860 weaving shed, Frostholme Mill, Cornholme*

120). Thus, despite the ornate character of the exterior of the mill it was clearly deemed appropriate that the interior could be plainer. This indicates that outward appearances were considered of prime importance.

Plate 120 *The vast attic floor, Saltaire Mills, Saltaire*

The emphasis on the exterior appearance of the mill is of considerable interest as it suggests that the architectural style of the mill was being used to make some sort of statement that was not as relevant within the mill complex. This is supported by archaeological and documentary evidence.

In 1863 William Fairbairn published his '*Treatise on Mills and Millworks*'. Fairbairn was one of the most influential engineers of his time and his works on mills greatly affected mill design and architectural treatment, and this is of considerable interest to this current discussion. In his 1863 treatise, Fairbairn described and illustrated 'uncouth' and 'improved' mill architecture (Plate 121). The 'uncouth' mill resembles many early mills, comprising a multi-storeyed rectangular box with no architectural pretensions. In contrast, the 'improved' mill is considerably larger and incorporates pilasters and other classical features. It is clear

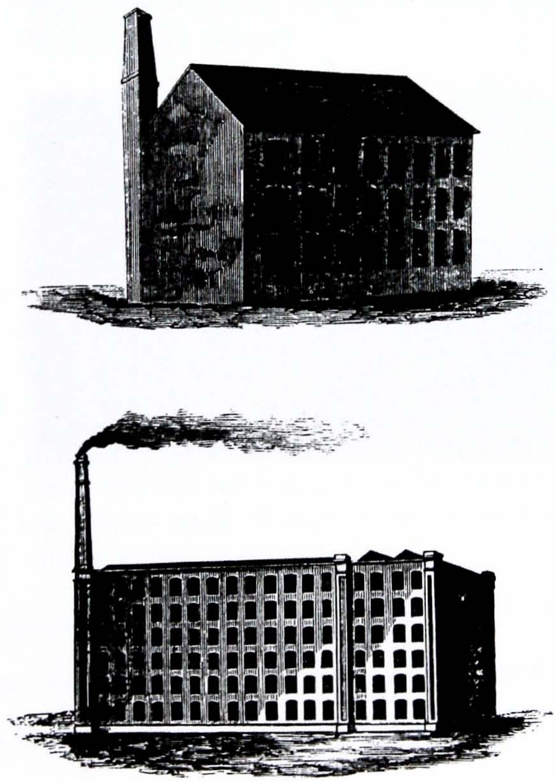

Plate 121 *William Fairbairn's 'uncouth' (above) and 'improved' (below) mills*

that Fairbairn's 'improved' mill design was widely adopted and it is no coincidence that Fairbairn's designs for Saltaire Mills, Saltaire (**A8**), were *the* material realisation of his new concept of mill design. However, it is clear that the 'improved' design was considered an improvement from an aesthetic point of view and in the landscape context of the mill rather than necessarily improving working conditions or the production process.

This much is apparent at Saltaire Mills, Saltaire (**A8**). Outwardly, the Italianate detailing of the mill complex and its office block are an exaggerated example of Fairbairn's improved mill architecture. The fact that the same style is used throughout the associated industrial settlement leaves little doubt that this architectural style and its widespread application was, in Fairbairn's view at least, considered the most appropriate form for the buildings of the textile industries. However, although the main facades of the mill complex are treated in an Italianate and Classical style, the elevations facing in to the mill yard are less intricately detailed (Plates 122 and 123). Indeed, the interior elevations of the complex are not dissimilar from the 'uncouth' style that Fairbairn had sought to move away from. The use of the improved style was therefore clearly meant as an outward expression of the mill whilst within the complex a plainer style was acceptable.

Plate 122 *Principal facade of office block, Saltaire Mills, Saltaire*

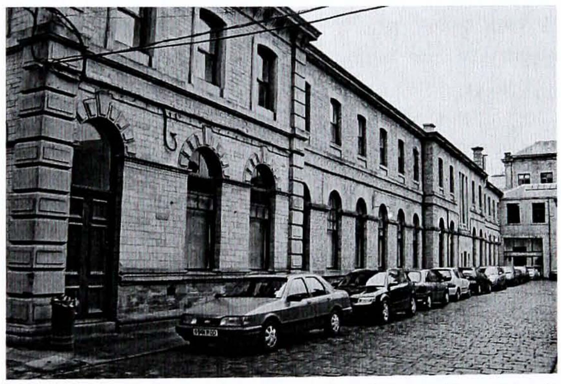

Plate 123 *The rear elevation of the office block at Saltaire Mills, Saltaire, is treated in a less ornate fashion to the main facade*

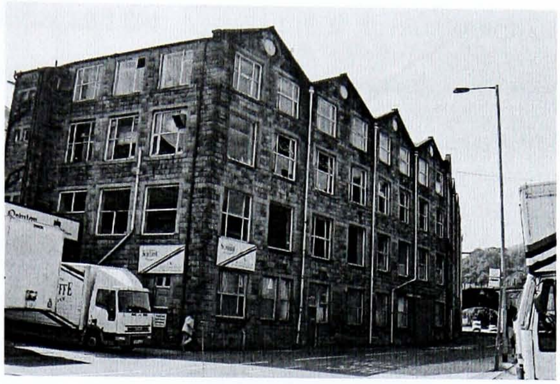

Plate 124 *North elevation of Frostholme Mill, Cornholme*

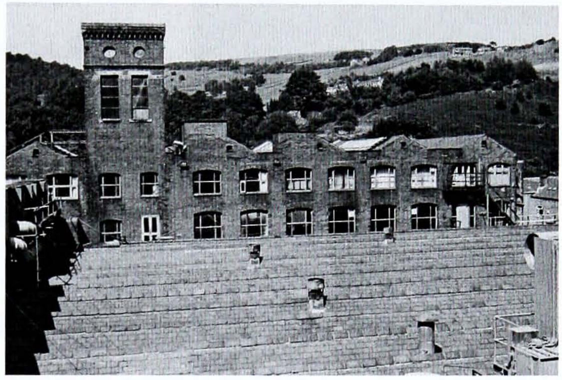

Plate 125 *The south elevation of Frostholme Mill, Cornholme, is built of red brick and is significantly less ornate than its northern counterpart*

This duality in the architectural style applied to the mill is also explicit at other sites. At Frostholme Mill, Todmorden and Walsden (**A10**), the main facade to the road frontage to the north, the only 'public' facade is built of stone and incorporates minor Classical details (Plate 124). This face contrasts with the red brick and rather plainer facade at the back of the main mill building (Plate 125). A similar contrast in styles is observable at Park View Mills, North Bierley (**A11**), where only the north and east facades are built in stone and the road frontage (the north facade) contrived in a busy Classical style. All other walls were built of brick. In contrast, at Victoria Mills, Elland (**A12**), and Ebor Mill, Haworth (**A2**), the high visibility of structures within the mill complex ensured that all elevations were treated in the same architectural manner. There is then, a clear difference between the architecture of the mill as a physical entity within a wider landscape and the architecture of the mill as a manufacturing complex.

Plate 126 *South elevation of Old Lane Mill, Northowram, facing the town of Halifax*

However, these same ideas were clearly in the minds of mill builders prior to the publication of Fairbairn's treatise. At Old Lane Mill, Northowram (**A4**), the south elevation facing the town of Halifax and the main approach to the mill was clearly contrived as a show facade (Plate 126), whilst at Aireworth Mills, Keighley (**A1**), the use of an ogee window (an unusual Gothic inclusion) in the gable facing the main route to Keighley and down the Worth Valley and a bell cote and clock drew attention to an otherwise plain mill. Fairbairn's treatise was therefore a confirmation of an existing tradition, but undoubtedly his published works and the material manifestation of his ideas at Saltaire led to the consolidation of the pattern and heavily influence future mill design. Even in the last generation of mills to be built considerable attention was paid to the main facade, as at Park View Mills, North Bierley (**A11**), or the visibility of the mill heightened through the raising of stair towers, as at Victoria Mills, Elland (**A12**), to house water tank but also as an opportunity to increase the visibility of the mill including a plaque bearing the name of the mill (Plate 127) Also increasingly common was the addition of mill names to mill chimneys.

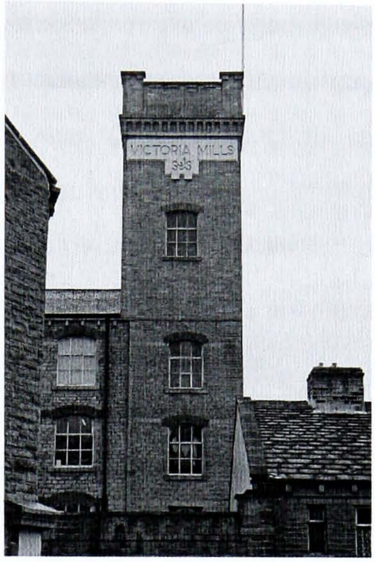

Plate 127 *The staircase tower at Victoria Mills, Elland, was raised in the 1920s and a decorative parapet and inscribed plaque added*

7.3 MEANINGFUL ARCHITECTURE: SOCIAL MEANINGS

It has been demonstrated that the dominant architectural style of the Yorskhire textile mill was firmly situated within a classical idiom, in particular an Italianate style. Traditionally, the choice of classical architecture for the textile mill has been interpreted in terms of the aspirations of the industrialist, in particular the desire to be accepted by the upper classes (see, for instance, Tann 1970). However, the archaeological evidence does not readily support this interpretation. As we have seen, the use of classical architecture seems to have origins related to the pre- and proto- industrial organisation of the textile industries when there was no apparent movement towards industrialisation *per se* and which was based on a long-standing social structure in which there is no evidence for a desire for social mobility in to the upper classes. Indeed, Brockman (1974, 21) has suggested that the Georgian style was deeply ingrained in builders/engineers of the buildings of the industrial revolution. It will be suggested that the use of classical architecture was used by the capitalists classes in a number of different ways and sent a variety of social messages to several audiences. Crudely expressed, messages were being sent to the working classes and to the gentry.

Giles and Goodall (1992, 24) have suggested that classical motifs were only used on the largest of early Yorkshire textile mills and have used this evidence to support the idea of mill architecture as a measure of entrepreneurial aspiration. However, even a cursory overview of early mills shows that relatively few sites were devoid of some degree of classical detailing and at some of the smaller sites, like Aireworth Mills, Keighley (**A1**), the use of a variety of different architectural motifs provides evidence to counter this view.

In addition, historians have shown the importance of money lending in the construction of new mills and the emergence of new industrialists during the early nineteenth century (Hudson 1986; 1992, 25-26). In particular, banks and attorneys played an important role in the industrial development of the industry. For the most part, bankers and money lenders came from the middle and upper classes. Thus, when James Akroyd ran out of money to build his Old Lane Mill, Northowram (**A4**), he borrowed more from the Rawson family, prominent landowners and bankers in Halifax, and some years later that family brought his mill and ran it as the heart of their industrial empire. This arrangement was not uncommon in the Yorkshire textile industry.

This evidence does not readily fit Tann's aspiration model, which stresses an acute desire on the part of the entrepreneur to be part of the upper classes. Rather, given the evidence for money lending and the important contribution of the gentry in the establishment of many industrial concerns, it would seem that the choice of polite architecture was something more of a necessity - that is to say, it was selected because it readily identified with those who, in many cases were supplying money or supporting the existence of the factory system. In terms of the emergence of the capitalist classes during the industrial revolution this suggests that such individuals readily aligned their interests with those of the upper classes and the choice of classical architecture was a material mechanism through which this was achieved.

This interpretation is supported by historical debate concerning entrepreneurship which has stressed that the economic environment of the early industrial revolution was favourable to the British industrialist and allowed men of small means to rise within industry. Furthermore, the upward mobility of the capitalist classes was not frowned upon by the gentry (see, for instance, Hudson 1992; 1986; Payne 1974) and therefore the entrepreneur did not have to aspire to elevate their social status, rather it was welcomed by those already higher in the social ladder. This is also evinced by the success of many entrepreneurs in political life, such as Sir Titus Salt, mayor of Bradford and a member of parliament and the interest shown by the aristocracy in technology, following the leads of those like Prince Albert, the Prince Consort, and the 'Great Exhibition'(Styles 1990) and recent studies of country house technology have shown just how innovative and 'industrial' the gentry could be (see Palmer 2005a). Alternative historical models of entrepreneurship emphasised the relative alienation of entrepreneur through their exclusion from politics and universities and attributed the triumph of the capitalist to their own economic stringencies and asceticism (see, for instance, McClelland 1961; Crouzet 1972; Weber 1976). This model, which predominated during the late 1960s and early 1970s, fits with the idea of mill architecture as a token of aspiration and it is no coincidence that when Jennifer Tann popularised this model it was during the early 1970s.

The idea that the choice of style for the textile mill was a deliberate attempt to align capitalist interests with those of the aristocracy is of further interest for it suggests the appropriation of the meaning of polite architecture as an expression of social status, in particular belonging to the upper classes. Johnson (1996) has suggested that by the eighteenth century the aristocracy had deliberately adopted the Classical style and the 'rule of taste' as a means of asserting their authority over the lower classes. This equated to a 'self-definition through the articulation of style' (Johnson 1996, 152). The gentry were a distinctive social class whose self-definition was being transformed in the course of the early modern period, culminating in the emergence of self-definition through the articulation of style and taste in the 18th century (Sinclair 1987). In the context of architecture, the choice of an architectural style was one material mechanism through which the upper classes made social statements about their own superiority and asserted and bolstered their position in the upper echelons of society. If we accept that the capitalist classes adopted the architecture of the upper classes for their mills then we may also accept that they appropriate the social meaning of polite eighteenth century architecture. Thus, the style of the mill made symbolic statements about the social standing of the capitalist classes - it aligned them with the upper classes and therefore placed them above the lower classes. This negotiation of social status between workers and capitalists was particularly important in the early stages of the industrial revolution when the emergence of the capitalists and working classes led to the re-definition of the class system and major upheaval to social relations.

This view is all the more compelling in the light of the spatial evidence from the mill (discussed in Chapter Six), which explored the extent to which the layout of the mill complex physically structured labour relations within the factory. Crucially, the structuring of labour relations was based on the supervision and the imposition of control over movement and the production process. This evidence is all the more powerful in the context of the mill. It has already been demonstrated that the spatial form of the mill imposed strict control over movement around the factory site and that, spatially and physically, the mill site was contrived to emphasise the action of coming to work, itself a symbol of the genesis of the centralised workplace. The independent site of production was also a symbol of the emergence of the capitalist and working classes. This was enforced through the choice of a classical idiom, which saw the appropriation of the same architectural statements that had previously marked the relationship between the upper and lower classes in the context of country house architecture, and applied them to the mill establishing the relationship between capitalist and worker. In this way the capitalist classes bolstered their own position and established their hierarchical relationship with the working classes. Combined with the spatial evidence, the form and style of the mill emerges as a powerful social tool manipulated by the industrialist.

The idea that the textile factory projected the same kinds of social messages through its architectural appearance as well as through its spatial configuration is particularly relevant to those mill sites with associated worker housing. At Gibson Mill, Wadsworth (**A3**) (built *c.*1800; Plate 128), Aireworth Mill, Keighley (**A1**) and Ebor Mill, Haworth (**A2**), (both built in the early nineteenth century) and Ardsley Mills, East Ardsley (**A9**) (built 1912; Plate 129), workers' housing was provided by the industrialist adjacent to the mill site. For the workers living in these houses the physical presence of the mill in daily life would have been palpable. Indeed, at Gibson Mill, Wadsworth (**A3**), and in the earliest phases at Aireworth Mill, Keighley (**A1**), the workers' cottages were physically part of the mill complex and accessed, like the main working areas of the factory, from the mill yard. Thus, whilst the advent of the factory system brought about a major spatial change and moved production out of a domestic setting, it is clear that both the physical relationship of mills to the workers' homes and the choice of mill architecture to project

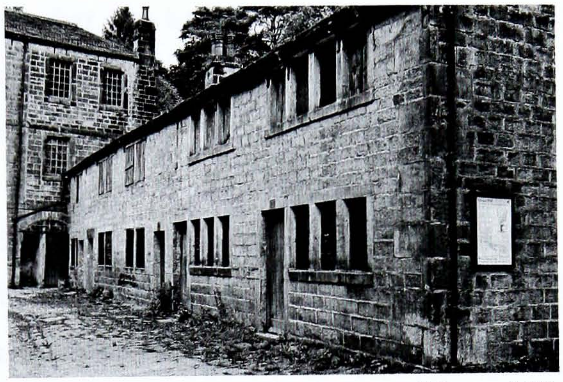

Plate 128 *Workers' housing at Gibson Mill, Wadsworth, immediately to the south of the main spinning mill*

Plate 129 *Workers' housing to the north of Ardsley Mills, East Ardsley*

specific social meanings, ensured the maintenance of authority on the part of the industrialist over his workforce even outside working hours. This occurred in much the same way as pre- and proto-industrial forms of production involving the yeoman clothier bringing raw materials to and taking away finished goods from individuals working from home. Of course, the degree to which control was exerted over workers outside of working hours varied. Many mills had clocks (as at Aireworth Mills, Keighley (**A1**), and Old Lane Mill, Northowram (**A4**), and other sites had bell cotes or steam whistles to signal changing shifts. Thus, the mill physically presided over local time and therefore structured both working and leisure time.

However, perhaps the ultimate exertion of control is visible in entire worker settlements and model industrial settlements. In Yorkshire, the supreme example is Saltaire (Saltaire Mills, **A8**), the model village built by Sir Titus Salt for his workers. Not only does the mill physically dominate the village but also the same Italianate style used on the mill is used throughout the settlement. Furthermore, the village, when first built, was relatively isolated and therefore workers were compelled to use the amenities, including schools, institutes and a hospital, provided within the settlement. In addition,

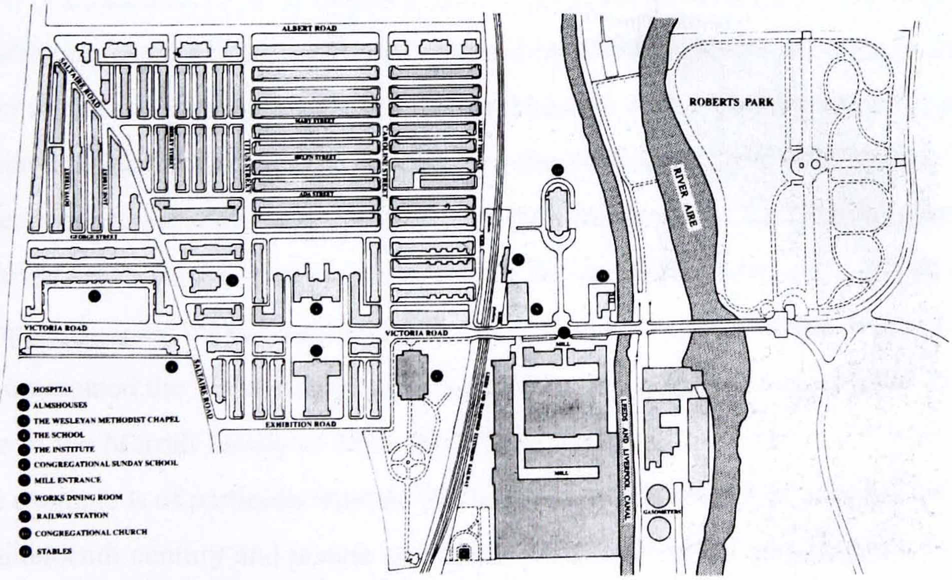

Plate 130 *The model village of Saltaire; the mill is shown bottom centre (Markus 1993a, 297*

the hierarchy of the workforce was mapped directly on to the layout of the settlement with over lookers and managers housed in larger houses at the end of rows whilst some of the manager's houses also had watch-out towers so that the actions of workers in their domestic setting could be observed (Markus 1993a, 294-5; Plate 130).

The social significance of the architecture of the Yorkshire textile mill, as an expression of the status of the capitalist textile manufacturer, apparently endured during the nineteenth and in to the early twentieth century. However, it is also clear that the significance of the mill also changed over time, most notably through extra significance being attached to the structures.

One of the major changes appears to have been a gradual shift from the mill as an expression of the individual industrialist to an expression of the company. The development of the mill as a symbol of the textile company that operated it is apparently commensurate with the rise of integrated sites from the second quarter of the nineteenth century which brought the business function of the firm (such as administrative office blocks) on to the mill site. Whilst this did not necessarily remove any of the emphasis on the role of the factory in defining relations between the capitalist and working classes, the mill took on an extra symbolism as a physical representation of the company operating it. Thus the classical style became symbolic of business relations as well as labour relations. Interestingly, whilst the architecture of the Yorkshire textile factory remained rigidly classical, the architecture of the Yorkshire textile industrialists' own houses more closely followed contemporary polite taste. Thus, by the late eighteenth century manufacturers' houses were built in the manorial gothic style and obvious examples included the baronial styled Dobroyd Castle, the home of the Fielden family who dominated the Todmorden textile industry, and Longlands House, Haworth, the home of the Merrall family of Ebor Mill, Haworth (**A2**)(Plates 131 and 132). The latter example is of particular interest for the house was built in the closing decades of the nineteenth century and is near contemporary with the 1887 spinning mill built at Ebor Mill. Whilst the mill was built in a classical style the house is gothic and this

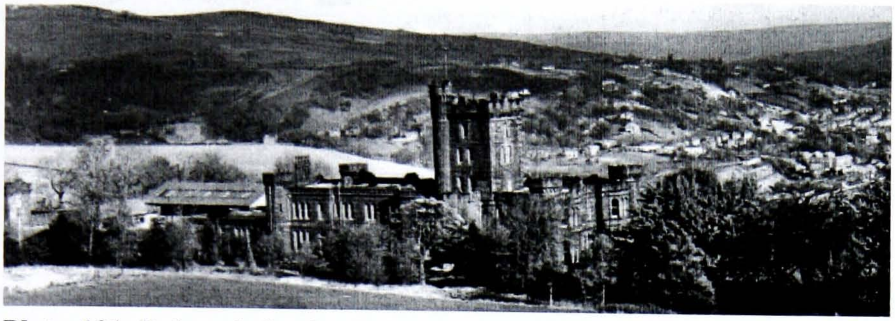

Plate 131 *Dobroyd Castle, Todmorden: built by the Fielden family in a Baronial style, c.1866-9 (Giles and Goodall 1992, 191)*

illustrates the growing gulf between factory and polite architecture. Of course, it also illustrates the fact that the textile manufacturer chose to build his own home in a style akin with contemporary aristocratic taste but persisted with classical detailing for his factory.

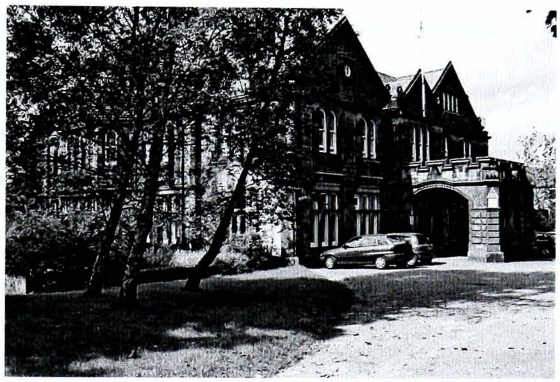

Plate 132 *Longlands House, Haworth: home of Edwin Merrall of Ebor Mill, built c.1884 in an Elizabethan-gothic style*

This interplay between the choice of architecture of the mill and the manufacturer's house own is of particular interest. It suggests that the industrialist was keenly aware of contemporary trends in polite architecture but only chose to model their own homes in a contemporary style whilst the mill remained classical and, by late nineteenth century standards, somewhat dated. This indicates that the mill represented one set of values whilst the manufacturers own home, another. Thus, if the mill reflected the character of the entrepreneur in the early industrial revolution, it was their own home that reflected their taste and social status by the late nineteenth century. The mill, therefore seems to have taken on a role as an icon of industrial achievement, to which the classical style had become attached. Of note, the industrialists house was usually sited within view of the industrial complex to which it was attached, presumably so that his industrial empire could be viewed from his home. Conversely, the symbol of his wealth and local dominance was visible to his workers.

This, however, raises an interesting issue about the meaning of mill architecture in terms of social relations between the capitalist and working classes. If, in the early and middle periods, mill architecture defined social hierarchies through the appropriation of a classical style, but, by the late nineteenth century, the upper classes were distinguished by Gothic architecture, we must question the continued role of the mill in defining labour relations. It might be argued that by the late nineteenth century, the architecture of the mill was less important in defining labour relations as factory working and the existence of the working classes was simply accepted, part of a industrial *habitus* at the level of the different classes. Thus, the physical presence of mill was enough of a symbol of factory working, and if, as it appears, the classical style emerged as a house style for the textile industries, then the symbolism remained potent. Furthermore, the visibility of a manufacturer's house built in the polite style (classical or gothic) from either the factory or workers' housing, would have been enough to enforce the same understanding of social hierarchies as classical mill architecture in the early period. These interpretations suggest multiple meanings for mill architecture over time and the manipulation of architectural styles and tastes to suit needs of social mobility, and business and social relations.

7.4 MEANINGFUL ARCHITECTURE: BUSINESS RELATIONS

It has already been shown (see Chapter Six) that there is spatial evidence to suggest that a degree of zoning with the mill complex defined some elements of the mill as 'public' and 'front stage' areas and which had a prominent role in the mill as an arena for business relations. This spatial evidence largely concerns office blocks and, apparently, steam engine houses, and the formal evidence from the mill would appear to confirm this observation.

From the mid-nineteenth century it was common for mills to incorporate purpose-built office blocks, and increasingly the detached office block became a feature of integrated mill sites. Offices are known in earlier mills, notably at Old Lane Mill, Northowram

(**A4**), (1924-5) but it seems that here, as at other early sites, the offices were used for the purposes of tracking materials and goods entering and leaving the mill or as time and over-lookers offices, rather than fulfilling an administrative function in the sense of a modern office complex. Indeed, the need for administrative offices at a site largely resulted from the growth of mill complexes with a greater output and larger number of workers as well as the development of an increasingly competitive business climate from the mid-nineteenth century onwards (Skinner 1997, 29). The office block and the interior of offices became one area of the mill that increasingly saw architectural elaboration.

Offices were incorporated into mill sites in two main ways, either as a detached block, or occupying an area within another mill building. In the case of detached office blocks, the architectural style used could either complement the rest of the mill complex, as at Saltaire Mills, Saltaire (**A8**), or, as at Ardsley Mills, East Ardsley (**A12**), adopted an individual style making it visually distinct from the rest of the manufacturing complex. At other sites, offices were located in a central, urban location distinct from the mill site. Internally offices, whether detached or within other buildings were usually decorative. Where this evidence survives it is clear that panelling, cornicing and built-in features such as desks, safes and cupboards were the norm. At Pecket Well Shed, Wadsworth (**A7**), the internal offices in the multi-storeyed warehouse and sizing block retain all their original fittings and are architecturally distinct from the plain interior of the rest of the complex, whilst the interior of the office block at Saltaire Mills, Saltaire (**A8**), was fitted out in magnificent style with panelling, stained glass, impressive staircases and marble fireplaces. The impression is then, that as well as being spatially distinct from the rest of the mill complex (see Chapter Six), offices were also architecturally distinct.

The particular attention paid to the architectural character of the office block is of considerable interest. The rise of integrated sites with their own office blocks was paralleled by the decline of many Cloth Halls, the traditional seat of business and exchange in the textile industries and although some mid-nineteenth century exchanges were built, such as the Wool Exchange, Bradford (1867), business gradually transferred to the site of production. In the embellishment of the office block we can perhaps see two processes. First, in the absence of an architecturally distinctive meeting place, the Cloth Hall, in which to conduct business, individual manufacturers provided their own distinctive buildings in which to conduct business. Second, in the absence of a communal meeting place, the on-site office block provided an opportunity for the industrialist to promote their own image and that of their company in a way that had previously only been possible through the buildings housing the processes of production. This may account for the office being particularly ornate, as at Saltaire Mills, Saltaire (**A8**), or being entirely distinctive by adopting a style in contrast to the rest of the factory site, as within the Jacobean-styled detached office block at Ardsley Mills, East Ardsley (**A9**).

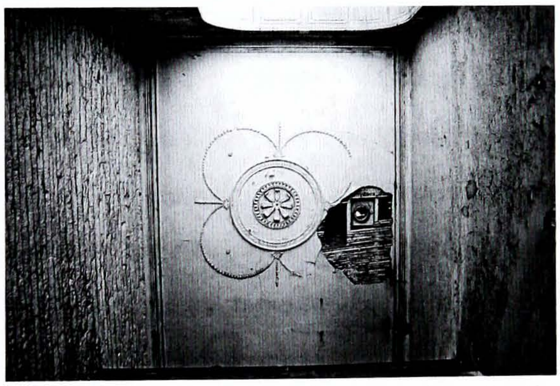

Plate 133 *The ornate plaster ceiling in the engine house, Old Lane Mill, Northowram, c.1825-28*

The other 'front' area, which may be construed as having played an important role in business relations and as an expression of the company, was the steam engine house. It has been commented above that not only did the exterior of engine house received a common treatment, with rusticated surrounds and typically tall, narrow round-headed windows, but it was also one of the few areas in the mill to receive internal embellishment. At Old Lane Mill, Northowram, the early beam engine house was particularly ornate with a moulded plaster ceiling and decorative beam and entablature floor (Plate 133). Other engine houses followed a similar pattern, though later engine houses tend towards a more rational appearance with the use of glazed tiles and ornamental brass work. Traditionally the embellishment and decoration of the steam plant at the textile mill has been seen as an expression of growing confidence in steam technology (Giles and Goodall 1992). However, this does not explain a tradition of embellishing the engine house long after steam technology had become established as the principal form of power. We must therefore seek an alternative explanation. Cumulatively, the spatial and formal evidence indicates that not only was the engine house designed to highly visible but also it was intended that their interiors should be viewed. Given that the interior of the rest of the mill complex was plain we may argue that the aesthetic qualities of the engine house were not for the benefit of the worker but for visitors to the site that were probably largely business related.

A pattern emerges of areas in the mill that performed some sort of 'public' function and which were spatially shallow in the complex as a whole and formally ornate. This implies that these areas were taken as symbols of the firm as a whole. Skinner (1997, 29) has argued that the competitive market structure of the industry encouraged increased efforts to promote the identity of the firm through the factory site. This was particularly important in an urban context where mills were densely distributed. This interpretation fits the archaeological evidence well. The spatial and architectural distinction of offices clearly reflected the important role of the office as the hub of business transactions and the public interface of the site. The engine house is more problematic to interpret in this context. However, the size of a mill and its productive output was largely dependent on the power source. Furthermore, the installation of steam plant involved considerable capital investment and with a thriving trade in second-hand engines the steam plant was costly to install (Hudson 1986). The engine house therefore had a symbolic quality. It represented the capabilities of the firm as well as its existing prowess in the industry and the availability of capital to install an ornate engine in an embellished engine house. Thus, whilst other areas of the mill interior were devoid of architectural details, effort was made to embellish the 'public' and symbolic areas of the mill.

The important role of the appearance of the mill as a symbol of the company operating it, as well as an enduring symbol of the capitalist, was emphasised by the role of the industrial architect. Brockman (1974) has argued that the industrial architect had a profound effect the development of industrial architecture from the mid-nineteenth century. This effect was varied. In the first place, several firms emerged as leaders in the field, such as Lockwood and Mawson of Bradford and Stott and Sons, Oldham and there was some importance attached to the use of such firms to design a mill (Linstrum 1978; Holden 1998). In the case of Stott and Sons, their characteristic red-brick cotton mills came to dominate Lancashire and where they were used elsewhere, as at Mons Mill, Stansfield, Todmorden (**BFO62239**), the East Mill, Belper, and at Masson Mills, both in Derbyshire, their mills were instantly recognisable. The use of an architect further emphasised the success of a business, and in the case of the leading mill designers, showed an ability to build in the latest style.

Furthermore, the rise of the industrial architect also led to something of an explosion of new architectural forms emerging within the rigid constraints of a classical style for the mill. Indeed, despite experiments it is clear that the industrial architect as well as the patrons of new mills understood that the overall style of the mill must be classical. However, idiosyncrasies did emerge. Most notable is the work of Stott and Sons, whose Lancashire cotton mills display a wealth of hitherto unused motifs, including Byzantine copper domes and, at Pear Mill, Stockport, the use of rather unusual but visually dominant copper pears at roof level. These idiosyncrasies reflect a desire not only to increase the overall visibility of a site but also emphasises the involvement of an architect in the execution of the design. At a more general level, the rise of the industrial architect and their effect on the industry is of interest for it counters interpretations of factory architecture that emphasise a lack of aesthetic qualities. It is clear, however, that following the rise of the industrial architect the use of embellishment increased and that even in the latest generation of mills the hand of the architect in devising visually stimulating facades is perfectly clear and does not, on balance, appear to signal the origins of the Modern Movement. Rather, and like the other formal evidence from the mill site, it appears to reflect a material mechanism through which the identity of the industrialist, and the textile firm,were expressed and their position within a wider economic and social environment bolstered.

CHAPTER EIGHT
CONCLUSION -
'TEMPLES OF POWER'

> '*While the engine runs people must work - men, women and children are yoked together with iron and steam*' (Dr. J. R. Kay 1832)
>
> '*In the backstreets around them were many mills, out of which poured streams of mens and women two or three times a day*' (E. Gaskell '*North and South*', 1854-5, 81)

Plate 134 *'Coming from the Mill', 1930. L.S. Lowry (Spalding 1987)*

Perhaps the most enduring image of the textile mill is that immortalised in the work of L.S. Lowry. In his *Coming from the mill* (1930; Plate 134), Lowry depicting a dark, unwelcoming building at the heart of an industrial townscape, a huge black framework with rows of yellow–lit windows looming over the little, pinched, black figures of the workforce in the street below. In Lowry's scenes there is undoubtedly a poignant social commentary and the contrast between the massive mills and the squalid flimsy dwellings of the workers conveys a strong post-industrial message (Rothstein 1984, 269). However, Lowry's paintings of mills depict a crucial element of the mill – the worker. At the heart of Lowry's work was a self-confessed fascination with men and women, and more specifically with the mills and the people – the social dimension of production (Spalding 1987, 31). It is that crucial social dimension that this thesis has sought to explore. It did not set out to disprove existing explanations of the factory system or dominant archaeological interpretations of textile mills, rather it sought to explore the potential of an alternative approach to the subject with a specific focus on the ways in which the mill as a physical entity structured labour relations and had meaning in the realm of industrial social relations.

This investigation was itself used as heuristic device through which to explore the potential of material culture studies to our understanding of the industrial revolution. Crucially, this thesis sought to develop a theoretical framework within which to set the archaeological study of the British industrial revolution.

8.1 THE TEXTILE MILL: SOCIAL SPACE AND MEANINGFUL ARCHITECTURE

The archaeological evidence from the Yorkshire textile mill provides a wealth of evidence about the social dimensions of production, much of which cannot be obtained from documentary sources alone. This thesis has, therefore, demonstrated the potential contribution of material culture studies to our understanding of the British industrial revolution and has highlighted a number of major issues about the ways in which the physical fabric of the textile factory structured labour relations during the period.

It has been shown in Chapter Six that the spatial form of the Yorkshire textile mill was designed to maximise control over the workforce. In terms of access analysis, at a generic level, mills of all ages had an inherently tree-like structure with only a few spaces at the base of the complex leading to the majority of the other spaces. This spatial form is noted as a means of imposing control over movement and the persistence of this spatial form across the age of mill building provide compelling evidence supporting organisational accounts of the rise of the factory system. Furthermore, it also provides evidence to support Markus' (1993a, 264) hypothesis that all factories have three structures - power transmission, spatial and social, for each of these structures are evidenced in the physical structure of the mill. Crucially, it implies that the factory was a *locale* within which labour and wider social relations were played out, in particular creation and maintenance of hierarchical power structures defining the relationship between the capitalist and working classes.

Access to Yorkshire textile producing sites was highly controlled and movement within the complex restricted. The mill yard was an effective means of containing the workforce within the mill site and it served as a transitional space between the outside world and the factory (p183-186). This had important implications for site security and the movement of goods and people within the mill site but it also had a major psychological function for it marked the point at which the workplace was separated from the outside world and, most importantly, from the domestic setting. The genesis of the factory system of production marked one of the major spatial changes of the period - the increasing separation of the place of production from the place of consumption, the home (Mokyr 2001). The action of moving between the outside world and into the mill yard was therefore formally and intuitively a powerful symbol of the wider changes to the dominant means of production and of the relationship between the working and capitalist classes. In this way the mill site as a physical entity helped structure individual and collective *habitus* at the level of both the working and capitalist classes.

The staircase tower (see p186-193), like the mill yard, was a powerful means of restricting the movement of workers around the mill site and within individual buildings. The staircase tower acted as the principal space through which movement occurred and it allowed workers to moved directly from the mill yard to the work floor. In the case of single-storey sheds a corridor usually replaced the staircase tower, though in some instances the main working area itself provided access to all other spaces in the complex thus focussing worker movement directly on the production process. The effectiveness of the staircase tower as a means of restricting movement around the mill complex is all the more marked at those sites where initially there was no staircase tower. At many early sites internal movement within multi-storey buildings was via open flights of stairs passing directly between each floor. This resulted in simple spatial structures wherein access to each of the main working spaces was directly from another working space. The use of a staircase tower, however, became increasingly common as its benefits for controlling human movement were realised, and many were added to existing buildings, transforming the inherent spatial structure.

The integrating role of the staircase tower had important implications for control within the Yorkshire textile mill. It has been shown (p191; 202) that many sites, the overlookers' office or time offices were positioned on the landings of staircases and immediately adjacent to the point of access from the stairs to the main working spaces. By virtue of the fact that these offices housed members of the workforce who had a supervisory role the position of their offices on the main access routes through the mill is highly significant in terms of the supervision of workers both on the work floor and about the rest of the mill. In some instances, overlookers' offices were located away from the staircase tower but usually were placed near to or within clear view of the main point of access on to the work floor allowing supervision of the movement of workers. Furthermore, it allows something of the hierarchical nature of the workforce to be 'mapped' on to the spatial structure of the mill, with those workers with a supervisory role most often located in spaces towards the bottom of the spatial structure and adjacent to the principal routes of access around the mill complex.

Other spaces within the Yorkshire textile mill complex are also significant in terms of understanding the movement of workers. The main working spaces within the complex tend to be located in the deeper parts of the complex and are not usually integrated within the spatial complex as a whole. This implies that they were not integral to movement about the mill and were therefore spaces designed to accommodate workers rather than to aid their movement.

It was usual for water closets to be provided adjacent to each of the main working areas and spatially they therefore are usually located in the deepest parts of the complex. In many early mills water closets were not provided but from the mid nineteenth century, and probably reflecting increased concern over working conditions in factories brought about by the Factory Acts, the growth of Unionism and increased social commentary on the effects of industrialization, sanitary facilities were a common feature of new mills and were added to existing structures. The spatial evidence implies that, by virtue of being furthest from the entrance to the mill, those water closets were the most private spaces in the textile factory. This is perhaps to be expected, but in fact oral history and the formal evidence from surviving mills suggests that privacy was not a major concern in the provision of water closets. First, it has been shown that privies were usually located directly off the main working areas or access to them was highly visible from the main working floor (p196-198). Thus use of them by workers could be supervised and time away from the production processes minimised. Second, at many mills only a few toilets were provided for each working area and at some sites there was a single water closet. In addition, mill rules often stipulated that only one worker was to use a privy at any one time. This evidence indicates that there was an interest to limit worker interaction and to minimise the number of workers absent from the production process at any one time. This is significant in terms of limiting possible worker interaction, as the factory was, after all, a *locale* for the coming together of the working class and therefore a possible location for the eruption of worker discontent. Third, oral history reveals that even during the early twentieth century, most water closets in mills were not fitted with full-length doors and thus those using them were highly visible from the main working floor. As the majority of water closets in surviving Yorkshire textile mills have been modernised, this source of information is highly significant and it supports the idea that activity away from the productive process was as highly supervised as time spent operating machinery.

The spatial evidence reveals further clear divisions within the workforce and between 'public' and 'private' areas, which are not immediately apparent from ground plans of Yorkshire textile mills alone. Administrative offices were spatially distinct from the remainder of the mill complex even where they were housed within the same building as other elements of the production process (p202-205). Spatial analysis showed that these offices occupied a distinct part of the spatial complex as a whole and that there was only one internal link between the offices and the rest of the mill. Naturally, the distinction between parts of the mill with an administrative function and those directly associated with the production of textiles reflects the number of different jobs undertaken within the mill especially as integrated sites became more common from the second quarter of the nineteenth century. However, the spatial evidence makes clear the extent to which different members of the workforce were spatially distinct from each other. Furthermore, because office suites usually had their own independent access they are placed within the lower, shallower parts of the mill complex in contrast to the main working areas of the mill directly associated with the production of textiles that were usually in the deeper parts of the complex. In terms of the regionalisation of the mill, this means that office suites tended to be 'frontstage', public spaces. Not only does this further map the hierarchical nature of the workforce on to the spatial structure of the mill, with office staff housed in the shallower parts of the complex, it also emphasises those parts of the mill to which the public and business contacts had access as opposed to those areas inhabited solely by workers.

These spatial demarcations are also clear from the evidence of boiler and engine houses. Almost without exception there is clear evidence for boiler and engine houses to be spatially distinct from the rest of the mill complex, usually accessed directly from the mill yard and with little or no internal access to the rest of the complex (p206-208). There is, of course, a clear functional logic for this arrangement, not least arising from concerns over the risk of fire, and it also reflects the fact that boilermen and enginemen/engineers were not directly involved in the production of textiles, which is confirmed by oral history. However, the location of engine houses, in particular, in the shallower parts of the complex and with direct access from the mill yard is of considerable interest, particularly when set in the context of the frequent embellishment of the interior of the engine house interior. This embellishment itself suggests that the interior of the engine house was intended for viewing by people other than workers and the location of these building in the shallower parts of the spatial structure of the mill, making them easily accessible, supports that idea. Such evidence suggests a degree of regionalisation within the mill as a *locale* for production and social relations with the engine house being a 'frontstage', public space, in contrast to the main working areas which tend to be located deeper in the spatial structure and may therefore be considered 'backstage' spaces inhabited only by workers. This points to the important role of the mill as a *locale* for business relations and wider social relations, by virtue of the fact that the steam installation seems to have been used as an expression of the company and the company owner - the mill builder. This is supported by the fact the exterior treatment of engine and boiler houses was remarkable consistent thus generating an architectural grammar which pointed to the use of steam power at the mill site in addition to the presence of a chimney or the viewing of the interior of the mill.

The spatial evidence for the imposition of control over human activity in terms of restricting access to different parts of the mill complex and limiting potential movement across the age of mill building in Yorkshire implies a continued desire to supervise the workforce and to control access to the mill site. Furthermore, whilst functional and practical aspects of mill design led to increasingly large mills with uninterrupted working areas, effected through the centripetal movement of features such as water closets and staircases into projecting towers, the spatial aspects of the mill suggests heightened social control which may be construed as an centrifugal movement towards increased restrictions over potential movement. Indeed, the intensification of social control was actually induced by the emergence of separate staircase towers and the movement of features out of the main working areas. Thus functional, technological and social factors affected the form of the mill, bearing out Markus' model of the factory. Crucially, it suggests a continued process of using the materiality of mill as a mechanism through which to structure labour relations and collective and individual *habitus* about life as a factory worker. The tenacity of this social control suggests that it remained important to structure relations throughout the period of industrialization and that even when new generations were being born within an industrial environment the need to differentiate between capitalists and workers and to impose control over the production process remained a defining factor of the factory system of production.

If the spatial evidence of the mill suggests an active desire on the part of the mill owner to impose control over workers and thereby not establish a supervised and hierarchical labour force but also to emphasis a wider social hierarchy and class relations between capitalists and workers, then we may conceptualise the textile factory as an enclosed environment within which the materiality of the mill was used in an authoritarian way. The formal evidence of the mill suggests a similarly authoritarian use projecting an image of the mill owner and their company to a wider audience.

The exterior treatment of the Yorkshire textile mill largely adopted a classical style incorporating Palladian and Italianate motifs across the age of mill building. By adopting the 'rule of taste' the capitalist classes ensured their upward mobility. This was not aspiration it was reality and there is clear evidence for connections between the upper and capitalist classes, notably through money lending to raise capital for the construction of mills. The form of the mill therefore aligned the mill owner with the aristocracy, even if only superficially.

This commonality between the capitalist and upper classes and the use of polite architecture by both classes is significant. In the context of the factory as a material mechanism for the controlling of social relations it is highly significant for it suggests the appropriation of the same social distinctions and hierarchies understood through polite architecture between the upper and lower classes before and during the industrial revolution. It has been suggested (Chapter Seven) that by adopting the form of the country house for mills it allowed the appropriation of the architectural meaning of polite architecture and was therefore used to establish new relations between the capitalist and working classes in much the same ways as relations between the gentry and the lower classes had been previously been marked through monumental and polite architecture in the context of the country house.

The tenacity of the classical style in the context of the mill is significant over time. First, the social significance attached to the architectural style of the mill was probably never lost and as a landscape feature the mill remained a potent symbol of the social and economic changes brought about by the industrial revolution. In this way the classical style became something of 'house style' for the textile industries and distinguished the mill from other forms of manufactory. Second, from the mid nineteenth century there is a marked increase in the application of classical motifs, in particular Italianate detailing to the mill. This may be partly explained by the rise of the industrial architecture and in particular some of the more idiosyncratic designs that emerged as well as the standardisation of the Italianate style for mills may be explained by the role of the architect. However, it also reflects the growth of the competitive market and, as the number of integrated sites grew and more sites incorporated office suites at the site of production, the mill became an important symbol of business. The extent to which certain areas of the mill interior were spatially shallow and therefore 'public' areas has already been commented on and fit the model of the mill as a *locale* for business relations. In this way, the architectural form of the mill was not only an expression of the individual mill owner but also symbolic of the company which operated from it. In a burgeoning urban context this was particularly important and accounts for increased attention paid to the ornamentation of highly visible elements of the mill complex such as staircase towers and chimneys. This may explain some of the more idiosyncratic or overtly classical designs of the late nineteenth and early twentieth centuries particularly the often ornate principal elevations of single-storey sheds that were obviously less visible than multi-storeyed mill buildings.

This evidence has a number of interesting implications. First, because the main working area was not integral to the movement of individuals it may be considered a static space in which workers were housed together. This has a functional logic in terms the production process and workers of certain skills being located in specific parts of the mill. However, it also supports organisational and, in particular, microeconomic accounts of the rise of the factory system. Oral history accounts have shown that within the workplace there was definite division between workers operating different parts of the production process and the spatial evidence confirms this. Furthermore, because the main working areas were easily supervised because there were a limited number of other spaces accessible from it, and therefore potential movement away from the production process was limited. Oral history has also shown that it was usual for apprenticeships to be undertaken on the work floor and therefore by housing workers with the same skills together in a single space it the transfer of skills and knowledge about the production process was made more efficient. Thus the spatial divisions within the workplace had logic in terms of the microeconomics of the firm and the need to supervise the workforce.

8.2 STRATEGIES OF CONTROL

In summary, the textile mill provides clear evidence for the imposition of control by the capitalist mill owner over the workforce. Furthermore, it is clear that this element of control mirrored wider social relations which were symbolised not only by the spatial characteristics of the mill but also by its formal attributes and as a landscape feature within a wider physical and social environment. The mill may therefore be defined as a *locale* within which a number of different fields of discourse were played out, including the redefinition of the classes, class relations and business relations, as well as more functional discourses including technological innovation.

The major characteristics of mill design, on the basis of archaeological evidence drawn from the Yorkshire cotton and worsted industries, is the extent to which attention was paid to the imposition of control over the workforce and labour relations. The spatial form of the mill allowed the workforce to be supervised at all times, regulated the movement of workers in to, around and from the mill site and also allowed the maintenance of hierarchical labour relations. This provides clear archaeological evidence to support organisational and microeconomic accounts of the rise of the factory system. A measure of the success of this strategy of control is the extent to which no evidence was found in the mill for the playing out of worker discontent or the identity of workers. Although Belford (*pers. comm.*) has observed in modern manufactories clear evidence for the personalisation of the workplace by workers including graffito and personal effects, no comparable evidence is known from mills during the industrial revolution. This implies that the personalisation of the workplace by workers was not allowed and that the element of supervision did not allow the opportunity to do so. Alternatively, the evidence may simply not have survived. However, no reference has yet been found to such activity in oral history accounts. It may, therefore, be the case that such personalisation took place away from the factory site - evidence from American textile producing sites in Lowell, Massachusetts, has found contraband and graffito hidden in worker boarding houses rather than within the heart of the factory (Mrozowski 1996), and a detailed study of worker housing and settlements may provide comparable evidence to balance out the picture within the context of the factory system. However, the existence of such evidence would support the idea that the factory itself was an enclosed and controlled environment and therefore a psychological as well as physical symbol of the increasing separation of the place of work from the domestic setting during the industrial revolution.

The authoritarian architecture of the Yorkshire textile mill also created an environment suited to the transfer of skills and knowledge about the production process. Spatially, the mill was a series of segregating working spaces within which workers with specific skills or responsibilities were housed. Interaction between different parts of the workforce was limited and therefore team working was established on the basis of individual processes or working areas. This environment was particularly suited for apprenticeships without necessitating any interruption to the production process. It was an environment which encouraged learning by rote and within which transaction costs were minimal. This bears out microeconomic explanations of the factory system based on the concept that centralised production had significant advantages in terms of the microeconomics of the firm as opposed to a system of production based on dispersed out-working.

This authoritarian character also extended in to its physical appearance and its role as a feature in the landscape. It has been suggested that the use of polite architecture for the mill building appropriated the same social meaning that country house architecture had in polite circles and marked the social distinction between the capitalist and social classes. Furthermore, it allowed the capitalist classes to align themselves with the interests of the gentry. It therefore played a major role in the redefinition of the class system during the industrial revolution. The architectural treatment of the mill was also important in the context of the business environment and was symbolic of the firm and the individual mill owner. Particularly in an urban context the outward appearance of the mill was important and although the greater majority of mills persisted with a classical style attention was paid to those elements of the mill, such as stair towers and chimneys, which could draw attention to the mill. In this way the mill became something of a company insignia and this may partly explain the more idiosyncratic designs that emerged particularly during the late nineteenth and early twentieth centuries.

It is therefore clear that Markus' three structures are borne out by the archaeological evidence from the textile mills of the Yorkshire cotton and worsted industries. Technological considerations clearly played a major role in the development of the mill complex but it was not the sole determining factor and equally important were social issues, principally the imposition of control over the workforce and the use of the mill as an expression of the capitalist identity, both in a personal and business capacity. Markus (1993a, 265) was therefore right in his assertion that the form of the archetypal mill responded to technological and social factors like a 'soap bubble' and that each played an equal and vital role in the emergence of the factory as a distinct building type and a material mechanism through which labour relations during the period were created and maintained.

8.3 MATERIAL CULTURE STUDIES AND THE ARCHAEOLOGICAL STUDY OF THE INDUSTRIAL REVOLUTION

The potential for industrial archaeology to contribute to wider historical debate concerning the industrial revolution is, therefore immense. Although nominally a study of a specific form of material culture, the textile mill, and framed by a specific agenda aimed at exploring the archaeological evidence for organisational accounts of the factory system and the material mechanisms through which labour and social relations were structured, this thesis has demonstrated a broader, and singularly important point. It is this: the study of the material culture of the industrial revolution not only has the potential to contribute to existing historical debate concerning the period, but, and crucially, many of the most exciting aspects of the period are only visible archaeologically. Industrial archaeology, therefore, has a distinctive and unique contribution to make to studies of the industrial revolution and the early modern period.

In the first place, industrial archaeology has a clear contribution to make to our understanding of the social dimensions of production during the industrial revolution. It is apparent that the process of industrialization, such as the route to factory-based production had a reflexive relationship with changing social relations. The rise of the factory system has been shown to be commensurate with changes to the structure of society and transformations to group identity and ideology. Inevitably, then, we find in the materiality of the factory the physical manifestation of these socially rooted changes. Crucially, the factory not only existed as a passive reflection of these changes but also played an active role in their maintenance and determined any future transformations. Equally important were relations between capitalists and the working classes and business relations, as well as the playing out of social and political ideologies. The factory was a microcosm of wider social change and dominant social ideologies. In the factory we therefore witness a clear relationship between the underlying principles structuring society during the industrial revolution and the spatial form and architectural treatment of the textile factory. Crucially, many of these issues are only visible within an archaeological context.

This raises an important issue about the role of industrial archaeology at an academic level. The idea that many aspects of the industrial revolution are more easily understood within an archaeological framework would appear to conform to the idea that the major role of industrial archaeology remains as a discipline 'supportive of other disciplines, historical, archaeological, and environmental' (Buchanan 2000, 33). Such a view clearly has parallels to the idea of historical archaeology as a 'handmaiden' to history, a view that this thesis set out to dispel. The potential of industrial archaeology as an archaeological sub-discipline in its own right, therefore demands detailed consideration in the light of the findings of this study.

We have established that material culture studies have an important, if not a fundamentally significant, role to play in the future study of the industrial revolution. However, the nature of that archaeological distinctiveness should be a stimulus to new research in the field and not a fact that further retards the discipline. Many of the new research agendas developed within the field and working within a broadly contextual paradigm, including this thesis, have resulted in something of a convergence of historical and archaeological agendas. They have recognised that material culture and documentary evidence are simply different kinds of media through which particular discourses were structured in the past, sometimes complementary and at others, contradictory. Such an agenda has framed some of the most interesting, exciting and informative archaeological studies of the post-medieval and early modern period and have led to something of a redefinition of the aims of British historical archaeology. This thesis too acknowledges the benefits of a more interdisciplinary perspective.

That said the distinctive archaeological qualities of historical archaeology should not be overlooked. Ultimately, whether their agendas are framed by wider historical debate or not, archaeologists working within historical periods have no contribution to make if they do not use the material evidence at their disposal in a distinctly archaeological manner. Central is the need for a theoretical framework within industrial and historical archaeology that allows archaeological methodologies to be developed that are specifically concerned with the exploration of the role of material culture in past socio-economic life.

However, the contribution of material studies to our understanding of the industrial revolution is not simply an issue of broadening the horizons of knowledge. It is also forms part of a very pressing intellectual debate, the future of industrial archaeology as an archaeological sub-discipline. Johnson (1996, 210-11) has eloquently argued, the challenge facing late and post-medieval archaeologists in England is to address pressing contemporary debates on both historical issues and on wider issues of theory, and this thesis has sought to demonstrate the relevance of this argument to industrial archaeology. Existing studies in the field have seldom risen to this challenge, but those that have, such as the seminal work of practitioners like Palmer and Neaverson (1998; 2001a &b) Campion (1996; 2001) and Nevell and Walker (1998; 1999) have proved a source of new research agendas and information concerning the period and, crucially, have shown other studies within industrial archaeology to be wholly inadequate within a modern archaeological environment.

This has resulted in increasing attention to the intellectual basis of the discipline with renewed attention to the wider aims of industrial archaeology. As a result, a number of policy documents and conferences originating from within the discipline, notably under the direction of the Association of Industrial Archaeology (see, for instance, Palmer 1991; 2005c ; Palmer and Neaverson 1998; TICCIH 2000). These important steps bear testimony that industrial archaeologists as a community have begun to accept the need for a change in direction, albeit the fact that, as yet, the nature of work in the field remains varied. It would be fair to say that this resembles the maturation of the discipline, and equated with Clarke's (1973) model of the intellectual development of archaeology reflects movement from consciousness, through self-consciousness to critical self-consciousness in one giant movement. This reflects the fact that industrial archaeology was one of a number of archaeological sub-disciplines to develop within the late twentieth century. It has not, therefore, had several centuries to develop in the same way the wider archaeological discipline evolved from Antiquarian interest in the eighteenth and nineteenth centuries to the sophisticated theoretical and scientific discipline that it is today. However, industrial archaeology has been expected to make such intellectual development in little over fifty years and at the same time has been dealing with a body of evidence that has evoked negative attitudes and has not been readily romanticised nor attracted the popular imagination.

Industrial archaeology has traditionally played an important and defining role in the identification, preservation and conservation of field evidence. Although vital to the survival of field evidence, much of this work has not been supported by a strong research element. However, effective conservation strategies and appropriate methods of preserving and presenting physical evidence are contingent on an appropriate understanding of that evidence in the first place. Archaeological intervention, whether below-ground or concerned with standing structures and entire landscapes, therefore equates to 'documented understanding' which has a prime role informing the process of conservation, preservation and cultural resource management (Baker and Meeson 1996, 19; Thornes 1994, 89; Meeson 1994, 253).

The implication is that without thorough archaeological research appropriate conservation and preservation is difficult. Traditional approaches within industrial archaeology have favoured technological interpretations and this ethic is reflected in the presentation of many industrial sites to the public. Conversely, where industrial sites have been presented with an emphasis on the human element of the industrial revolution, like the Beamish Open Air Museum or the Black Country Museum, that social history has often been portrayed in a negative light with the greatest attention to low-standards of living and declining welfare at the expense of industrial progress. However, this thesis, and other comparable work in the field, has demonstrated that industrial archaeology has a wider contribution to make to our understanding of the social context of industrialization. On the basis of this new understanding, the conservation and preservation of industrial sites and their presentation to the public can reflect that new understanding. In turn, this may transform the popular image of both industrial archaeology and the industrial past based upon a realisation that some of the most interesting information about the period is only attainable through archaeological investigation. Thus, it will not only inform the way that the industrial revolution is remembered, but also the production of those memories in the future.

The implications of a revised understanding of the industrial revolution with an increased emphasis on the social dimensions of production also promises to transform industrial archaeology as a discipline in the eyes of its practitioners and those from outside the field.

One of the greatest characteristics of industrial archaeology is its high amateur involvement. A renewed approach to the physical remains of the industrial past, with a greater emphasis on the archaeological character of the discipline, not only has the potential to engage a new generation of amateurs in archaeological research but also provide a whole number of new possibilities to existing practitioners. The development of industrial archaeology as a distinctively archaeological discipline with a higher level of academic and professional credibility need not alienate those individuals that have played such a crucial role in the development of the discipline, and, ultimately, its continued existence. Indeed, the discipline should not seek to do so. Rather, it should seek to develop as a community. In many ways this equates to a continuation of existing work in the field, reflected in the aims of major institutions in the field, such as the Association for Industrial Archaeology (AIA) and its house journal, the *Industrial Archaeology Review* which have long aimed to:

> 'encourage improved standards of recording, research, conservation and publication, as well as to assist and support regional and specialist survey groups and bodies involved in the preservation of industrial monuments' (Palmer and Neaverson 1998, 2).

Indeed, it is refreshing to see that not only does membership of the AIA continue to thrive, but that new developments within the field have been readily accepted and, in many instances actively encouraged, by luminaries such as R.A. Buchanan (see, for instance, Buchanan 2000). From within the discipline there is the clear evidence that such change is possible.

From outside of industrial archaeology, the development of the discipline is equally attractive. Although changes within the professional field, notably the advent of Planning Policy Guidelines PPG15 and PPG16 have led to an increased awareness of the importance of post-medieval archaeology, there still remains some distance to go before post-medieval and early modern subjects receive a proper representation. Similarly, within the academy, the rise of post-medieval subjects and wider debate concerning archaeological and documentary sources has raised the profile of historical archaeology, but not necessarily industrial subjects. However, developments within the field promise to bring about further recognition about the importance of industrial remains and their contribution to cultural resource management and wider historical debate. The growth of this awareness is already evident. Work with an industrial theme has found increased representation in popular publications such as *British Archaeology, Current Archaeology* and *Antiquity*, and some professional units, notably ARCUS, Sheffield, have established a reputation for a commitment to industrial projects and the social archaeology of the recent past.

Trinder rightly observed that industrial archaeology has begun to bring into modern British history a 'vast agenda of questions about the nature of work, the sources of technological change, the character of settlements, gender roles and many other kinds of social identity (2000, 53). Whilst we may question the extent to which all of these areas have successfully been approached by industrial archaeologists, it is fair to comment that these questions are beginning to be asked and as they continue to be investigated the profile of industrial archaeology within a professional and academic sphere will continue to rise. More importantly, as industrial archaeology further demonstrates its distinctive contribution to our understanding of the recent past, its interdisciplinary participation will be fully realised. It will not stand as a mere provider of evidence, but as a distinctive sub-discipline in its own right with its own agendas that may be used to frame or work alongside research agendas established within other fields.

Furthermore, industrial archaeology has a vital role to play in the wider development of British historical archaeology. A major part of the rationale underlying this thesis was framed by an awareness of the difficulties facing the archaeological of historic periods in Britain, the place of industrial archaeology within that wider intellectual field. The research agenda therefore reflected these factors and was, at one level, designed to resolve some of these difficulties. Key was the idea that historical archaeologists should face the challenge of addressing contemporary historical debate and archaeological theory (Johnson 1996, 210-11) and this played a major role in framing the research agenda to be employed. The findings of this study bear testimony to Johnson's argument.

Of prime interest this thesis has demonstrated the potential role for industrial archaeology, like other aspects of British historical archaeology, to contribute to a broader corpus of literature concerning the writing of human histories. It is not without irony that one of the seminal examples of this tradition is seen in the work of W.G. Hoskins (1955), whose central theme was the desire to re-discover a sense of community and provincial culture perceived as having been swept away by the Industrial and Agricultural revolutions of the eighteenth and nineteenth centuries. Hoskins understood the need to place documentary history within a material context and listening to the past on its own terms, through historical and archaeological texts. For Johnson (1996, 212) it is the writing of human histories that is the wider project of historical archaeology and the achievement of luminaries like Hoskins cannot be ignored. The opportunity for industrial archaeology to contribute to the writing of the human history of the industrial revolution and the early modern period can similarly not be neglected. Industrial archaeology should therefore seek to contribute to the wider project of historical archaeology. By virtue of its periodisation and subject matter, the archaeological study of the industrial revolution has a place within the wider chronology covered by British historical archaeology and recent developments within post-medieval archaeology (see, for instance, Johnson 1996; 1993; Giles 2000; Newman 2001; Moreland 2001; Carver 2002) have established a rigorous archaeological baseline that industrial archaeologists are well-placed to contribute to and to extend through their studies into twentieth century archaeology.

8.4 FUTURE DIRECTIONS

The implications of this thesis are also relevant in a purely academic sense and the ways in which this kind of study might inform future research within industrial archaeology is worthy of consideration.

An obvious projection of this work would involve consideration of a wider variety of industrial and pre-industrial building types, between and across industries. Much of the inspiration for this work was derived from the work of T.A Markus, in particular his seminal research into the origins and development of modern building types (Markus 1993a). Although this study chose to focus on the textile mill and therefore only drew on a small part of the empirical work undertaken by Markus, potentially this archaeological agenda could be projected onto the study of any of the three main categories of building that Markus was concerned with: those that control relations between people directly (schools, institutions, assembly rooms, clubs, hotels); those which reproduce knowledge (museums, libraries, galleries, panoramas); and, those used for production and exchange (markets, factories, shops). Because Markus' investigation of these categories of buildings is ultimately concerned with understanding their role in determining social relations and their intimate relationship with broader social and cultural principles, each would be susceptible to the kind of archaeology agenda outlined in this thesis. The full archaeological investigation of each of these types would contribute significantly, not only to Markus' work but also our understanding of the emergence of the built environment since in the post-medieval and early modern periods.

At a more specific level, the research agenda outlined in this thesis might be applied in a number of different ways. In the first place, the further study of the buildings of the textile industries would be of interest. This thesis has nominally been a study of the Yorkshire textile mill, with a focus on the cotton and worsted industries. It has therefore adopted a specific regional and sectoral perspective and a periodisation based on the age of mill building within that location. By applying this methodology to other sectors of the Yorkshire textile industry and to other geographical areas notable for the textile production during the industrial revolution, including East Cheshire, Greater Manchester, the Derwent Valley and the West Country. An increasing corpus of literature concerning textile production in these regions (see, for instance, Trinder 1992; Williams and Farnie 1992; Calladine 1993; Calladine and Fricker 1993; Menuge 1993; Stratton and Trinder 1998; Palmer and Neaverson 2005) provides an important baseline for future study, just as the work of the former Royal Commission on Yorkshire textile mills (Giles and Goodall 1992) has played an important role in establishing the structural and technological development of mills in the area. The regional development of the textile mill and differences between a wider number of sectors of the textile industries than that examined here could prove an important area of research complementary to this thesis and essential in establishing the broader context of the development of the factory system within the textile industries at a national level. Furthermore, archaeological work adopting a regional framework would reflect a growing recognition within industrial revolution history of the important regional character of industries and the process of industrialization during the period (see, for instance, Berg 1994a; Hudson 1992).

A similar approach may be adopted at an international level. The work of institutions like TICCIH and an increasing number of industrial sites regularly added to the list World Heritage Sites by UNESCO have drawn attention to the importance of Britain as the birthplace of the industrial revolution and the global spread of industrialization as a unique phenomenon. The spread of textile manufacture and the factory system at an international level raises a number of possibilities. At one level, the spread of architectural forms readily identified in England raises interesting questions about the cultural and society significance of the factory and its symbolism as a reflection of the spread of industrialization. Riley (1998) raised interesting questions about textile mills in Łódź, Poland, the extent to which their design was the result of indigenous culture or functional imperatives. That study concluded that cultural differences were subservient to functional imperatives but the greatest attention was paid to the expression of technological requirements in the mill and not to elements of factory design responding to organisational and wider social and cultural issues. The potential of this current study to augment this work is clear.

At another level, the global spread of industrialization and the cultural significance of the mill and factory as a distinct form of manufacturing and as a readily identifiable physical entity have implications for our understanding of interaction between different nations and the process of enculturation. Research in this context has been forthcoming, but not directly related to the factory. For instance, Geijerstram (2000) studied the spread of Swedish technology and design of blast furnaces into India, noting evidence for the transfer of European technology and its implications for traditional Indian iron working from the mid-nineteenth century. A major part of the study concentrated on the evidence for harmony and conflict between the two technologies, in particular the obliteration of local working practices under colonial rule. This sort of study has interesting implications for our understanding of the spread of industrialization and the process of colonialism. Those patterns observed within British industrial buildings and their social and cultural significance are heightened in those instances where there is the transfer of such patterns as part of a wider cultural and political agenda and is therefore of considerable interest.

The archaeological study of industrial buildings, between and within different sectors and at a regional, national and international level has considerable potential. Similarly, the archaeological study of pre-industrial and industrial structures has a major contribution to make to wider historical debate. This study has concentrated on the factory *per se*, but a similar methodology might easily be projected onto pre-industrial forms thereby allowing a closer study of the evolution of industrial forms of manufacturing in the pre-industrial period. This might also be developed to explore the social significance of the architecture of those traditional forms of the manufacturing that co-existed alongside the factory during the industrial period. The latter in particular, might impart new evidence crucial to contemporary debate concerning the reasons for different scales of production during the industrial period and the different routes to industrialization proper adopted within and between different industrial sectors. Furthermore, and in the context of modern historical studies of the development of the office environment (for instance, McDermott 2001; Mokyr 2001), industrial archaeology might hold answers to twentieth century trends in the design of the workplace. Particularly germane is the current trend for working from home, which represents the reversal of the fundamental spatial change brought about by the factory system – the separation of the workplace from the domestic setting. The potential of material cultural studies in such a modern context remains largely unexplored and currently remains the preserve of business and architectural studies.

The extent to which the methodology adopted in this thesis might be readily applied to industries that were not organised on the basis of mass-centralised production within the factory is worth considering. Although industries such as coal mining were obviously not factory-based, they still represent centralised production. Furthermore, even across varied industries, industrial sites shared some common characteristics such as a central yard, offices and warehousing, and few sites were devoid or any architectural treatment, no matter how sparse. A concerted programme of recording and study across a variety of industries may therefore reveal elements of continuity between industries hitherto considered unrelated. In addition, it may be possible for evidence for differences between certain sectors of industry to reveal something about the relationship of different industries to each other and, crucially, their representation to society. Were some industries subject to elaborate architectural treatment because they were considered socially more acceptable whilst others were considered 'uncouth'? To what extent might this reflect patterns of consumption, the development of the market environment and the rise of an advertising and media culture?

Through its focus on the factory *per* se this thesis has not sought to develop a detailed understanding of the ways in which factories functioned as part of the physical landscape and local settlements or explored comprehensively the wider use of those architectural treatments observed at the mill site (such as Caffyn 1986; Palmer and Neaverson 2001). Clearly, particularly in those instances of model industrial settlements, there was often a close physical relationship between the setting of the mill and associated worker housing and, in some cases, a strong resemblance between the factory building and other buildings, such as town halls and institutions, built by the local entrepreneur. A fuller understanding of these close relationships and the complex social and cultural nexus of which they were undoubtedly part stands as a potent future interdisciplinary research project for industrial archaeologists, historians and art historians.

The research agenda adopted in the thesis necessarily took a broad approach to labour and social relations during the period, but the same methodology could be used to look at some of the more subtle aspects of social practice within the factory and during the industrial revolution. A particularly interesting project would be the exploration of gender roles within wider labour relations. Gender studies have assumed an important role in modern interpretations of the industrial revolution with particular attention paid to the role of men and women in working-class politics, domestic ideals and gender ideology during the period (Hudson 1992, 35). Within the factory it is clear that there was a degree of differentiation on the work-floor between the roles of women, men and children, with certain processes, such as spinning, traditionally operated by women and children. The idea that gender roles might be revealed through formal spatial analysis is particularly exciting and within an industrial context there is a wealth of documentary evidence to help identify gender specific areas within the factory and to relate them to observed spatial and social patterns. This type of study has been used to great effect in the study of medieval monasticism (Gilchrist 1994) but, as yet, its application to an industrial subject has not been fully explored.

Other factors germane to an industrial context, such as the introduction of different ethnic groups into the workplace in a twentieth century context may also prove ground for new research. Oral history has shown that there were tensions in the workplace between different racial groups following mass migration to England in the mid-twentieth century (A0006; A0184). It is apparent that these tensions framed the working experience of thousands of employees and exploring the possible manifestation of such racial divisions, if they existed, may significantly contribute to our understanding of the workplace in the twentieth century. In Yorkshire, these issues are especially relevant as the introduction of a large ethnic population was inextricably linked to the textile industries and transformed the character of the main urban centre such as Bradford and Leeds. The modern history of labour relations is therefore relevant to a wider project of modern social history. Certainly, the wider social context of life in an industrialised society has begun to form the subject of new research, in particular that concerned with leisure activities such as sport and cinema in a nineteenth and twentieth century context (see, for instance, Wood 2005; Richardson 2005). A renewed focus on the workplace has the potential to complement these kinds of studies.

This study has also illustrated the potentially vital role that oral history has to play in the archaeological study of the industrial period and future work in the field should not overlook this vital source of evidence that is unique to the history of the early modern period. Oral history is of considerable importance to our understanding of the social aspects of the industrial revolution and industry in the early twentieth century because it literally provides a voice from the past. Even though many of the interviews available are concerned with industry during the early and mid twentieth century, this study has shown how archaeology can reveal continuities in the design of industrial buildings from the late eighteenth to the early twentieth century. By applying oral history to early twentieth century examples it is possible to project the same findings back on to earlier archaeological examples. The increasing importance of oral history to industrial archaeology has been demonstrated by a number of recent studies, notably work originating from Manchester University (see, for instance, Casella 2005a and b). The opportunity should not be missed for industrial archaeology to both fully utilise existing sources of oral history and to seek new interviews as a supplement for their work; a particular germane example is provided by late nineteenth and early twentieth century closures in coal mining, for instance, a generation of miners and their experiences forms a ready source for new oral history. Industrial archaeology has the advantage of being concerned primarily with the study of the recent past and therefore a major direction for new work should be the exploitation of new forms of historical sources which are simply not available for earlier periods. Work concerned with the possible application of folk song within an archaeological context (see Young 2002) has begun to illustrate the potential of such an approach. Industrial archaeology may yet prove itself in this area above all others and make a significant contribution to the intellectual development of British historical archaeology.

8.5 CODA

The textile mill, like other types of industrial building, survive as a reminder of those significant changes to technology, social and economic life that we know as the industrial revolution, and bear out the important role that Britain played as the birthplace of industrialisation. In a modern context, old industrial buildings have assumed significance at the heart of urban regeneration and part of modern culture as a source of fashionable dwellings, offices and amenities. The process has therefore come full circle. Industrial buildings have resumed a social significance. In many areas, industrial buildings define the local townscape or rural landscape. The textile mill in West Yorkshire, for instance, still dominates many settlements; it remains a source of memories and, in the majority of cases, continues to play a special role at the heart of communities. Generations of the same families that worked in these buildings, and whose very existence from the late eighteenth to early twentieth centuries was an integral part of the mill, continue to live in the shadow of these buildings. Like their predecessors, the existence of the mill continues to inform their lives. It remains a source of local identity, a symbol of the industrial transformation of the local area and a defining feature in people's individual histories.

It is this vital social dimension, as strong today as it undoubtedly was in the past, which has so often been over looked in previous archaeological studies of the factory. Industrial archaeology has therefore overlooked a very real part of the story of the industrial revolution. However, industrial archaeology has a vital role to play in examining and understanding the social context of production during the industrial revolution and the full socio-economic implications of industrialisation, and in doing so may make a significant contribution to make to wider historical debate. It has the potential to contribute to large-scale research as well as to regional and local studies, providing an insight into the lives of those at the heart of the industrial revolution. The concept of the human history of the past has become a central theme within post-medieval archaeology and increasingly research agendas are being developed to address that theme. This thesis has shown that the mill, perhaps one of the most instantly recognisable forms of industrial revolution material culture, played a major role in that human history. This is poignantly illustrated at the time of closure of Frostholme Mill, Cornholme, Todmorden and Walsden in 1968. When the looms stopped for the last time and the last final left the mill, a documentary team from the BBC recorded events. Two days later, a former weaver and local resident stood outside the mill, giving an interview for the closing shots of the programme. Asked about the impact of the closure of the mill, he remarked:

> 'I think, [its] a great blow to the village, you see. There's people who've worked here all their lives, they've never been at any other mill, they're part of the village community. You give a big slice of your life to it, all these attachments, the people you work with, the people you have known all your life' (BBC 1968).

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The archaeological evidence from Yorkshire therefore suggests that the use of Classically inspired motifs in the earliest phase of mill building between *c.*1780 and 1829 was not restricted to the largest mills, but was in fact a relatively common feature of the emerging textile mill, though the extent of its use varied between individual sites. In particular, there is evidence from a number of earlier sites built with steam installations, for the interior decoration of the engine house and use of formal motifs on the exterior, commonly rusticated surrounds to engine house windows and boiler house doors, to apparently draw attention to these parts of the mill complex and, by virtue of its virtually universal application, became something of an architectural grammar for the mill.

Between *c.*1830 and 1879, advances in structural engineering led to an increase in the overall size of mills. Commensurate with this was a greater use of Classical motifs. In particular, the Italianate style predominated and early deviations from this style, such as the use of a gothic ogee window at Aireworth Mills, Keighley (**A1**), in 1808 and John Marshall's Egyptian style 'Temple Mill', Holbeck, Leeds (**BFO41529**), built 1838-40 (Linstrum 1978, 289-90; Plate 106), are best seen as idiosyncratic experiments outside the mainstream architectural development of the textile mill at this time. Giles and Goodall (1992, 29-30) have suggested that middle period mills larger copied the form of earlier mills and that Italianate detailing was applied selectively. However, the archaeological evidence indicates an increasing use of Classical motifs, no doubt reflecting their use at a number of influential sites, notably Sir Titus Salt's Saltaire Mills, Saltaire (**A8**), built *c.*1853, the increasing importance of the industrial architect in mill design which led to increasing attention to their aesthetic qualities, and as a response to mounting criticism levelled at industrialists

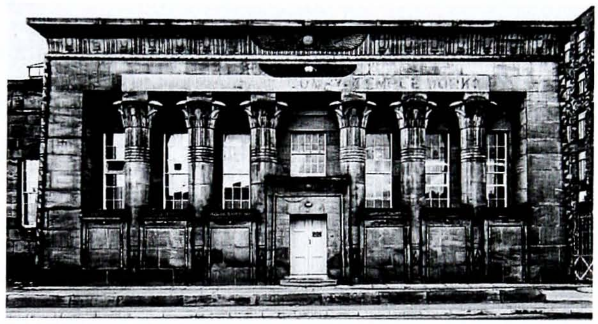

Plate 106 *Temple Mill (Marshalls Mill), Holbeck Leeds- a experiment in Egyptian styling (Giles and Goodall 1992, 56)*