Landscapes of Power: The Cultural and Historical Geographies of Renewable Energy in Britain since the 1870s

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Abstract

This thesis considers historical applications of naturally renewing energy resources in Britain from the beginnings of public electricity supply in the late-nineteenth century to the period immediately prior to the first State interest in such technology in the early 1980s when it became conceptualised as 'renewable'. After a comprehensive review of twentieth century engagements with renewable energy and the academic literatures pertaining to 'water, engineering and landscape' the thesis focuses on two distinct case studies. The first charts the technological, cultural and political evolution of hydro-electricity for public supply which developed over the course of the nineteenth century and was instituted from the 1870s. Detailed consideration of the Worcester hydro-electric station reveals that the development of hydro-electricity in the late-nineteenth century symbolised a wider social and cultural demand for 'civic improvement', and highlights the nature of water as a contested resource within late-Victorian civic arenas. The second traces the history of the Centre for Alternative Technology (CAT), a practical demonstration of alternative energy technologies established in rural mid-Wales during the early 1970s. In a discussion centred on 'alternativeness', the exploration of alternative energy technologies in the early 1970s was the preserve of an emerging counter-culture which sought to implement new visions of Environment and Society. Having revealed these hitherto dormant histories, the thesis concludes with a comparative discussion of the two case studies reflecting on these respective renewable energy projects and their uses as instruments of 'modernisation' and attempts to extract the significance of these histories in the context of current discourses of renewable energy.

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1 Introduction

> A vaster supply of energy than can be had from the coal of the whole world is to be found in the rise and fall of the tide upon the submerged plateau which is the foundation of Britain. No one has yet devised a satisfactory method of harnessing the tides, but the electrical conveyance of power has removed one of the least of the impediments, and sooner or later, when the necessity is upon us, a way may be found of converting their rhythmical pulsation into electrical energy (Mackinder 1902: 339 in Short *et al.* 2003: 1).

This was the prophecy in 1902 of the eminent geographer Halford Mackinder. By the turn of the twentieth century the industrial revolution of the eighteenth and nineteenth centuries had resulted in an equally revolutionary technological phase of development which had been gaining momentum from the mid-nineteenth century and which both fostered and facilitated the production of electricity. As well as from coal and gas, by 1881 the natural motive force of water was being harnessed on an increasing scale for the production of electricity for public supply through hydro-electric power generation. For Mackinder, the application of this technology to the latent energy harnessed within the tides of the British coastline constituted a natural progression in this energy-technology revolution to which Britain's otherwise latent natural resources could be put to use. The benefits of such resources to humankind's increasingly industrialised and technologised world encompassed a distinct way of seeing Nature which was being increasingly appraised in terms of its utility to human civilisation, a vision of nature that would be reflected through particular engagements with British landscapes over the course of the twentieth century.

Mackinder's statement was perhaps borne out of concerns over the increasing coal prices which along with the comparative cost of gas characterised late-nineteenth century discourses of electricity production encouraging the development of alternative energy sources, specifically water. However, this limiting factor was increasingly coupled with issues of availability, a factor to which Mackinder alludes in the final sentence of the above quotation and one which became increasingly influential to energy generation debates in the closing decades of the twentieth century. The importance of the relative cost of respective sources of electricity production has continued to inform twentieth century energy debates at a time when competing environmental concerns over both resource depletion and carbon emissions have eventually forced State engagements with alternative sources of electricity production.

Issues of 'Energy' and 'Environment' occupy a central position in early twenty-first century political discourse. Contemporary renewable energy debates have received considerable attention in the global media and from diverse academic disciplines as issues of energy become an increasingly critical area of political, environmental and cultural discussion as the potentially devastating effects of global climate change are realised. Contemporary discourses of renewable energy, focused on windfarm development, reveal the issue as fiercely contested, characterised by vociferous local debate, demonstrating the significance of firmly held ideas of landscape, nature, environment and national identity to the theoretical and practical arguments informing the decision-making process over its large-scale adoption for public power supply (Blowers and Elliott 2003). However, these debates proceed with little sense of history.

This research seeks therefore to address this void by exploring both the cultural and environmental history of renewable energy in late nineteenth and twentieth century Britain. These structures in the contemporary era have come to be understood as objects of 'renewable' or 'alternative' energy. However, this understanding of naturally renewing sources of energy is specific to the late twentieth century having only gained discursive power from the early 1970s. According to *The Oxford English Dictionary* (Murray *et al.* 1989) the first printed reference to the term 'renewable' appears in 1971 in *Scientific American* (43/2) as "Continuous, or renewable, energy supply [which] can be divided into two categories: solar and non-solar". Interestingly, even in its earliest articulation, the concept of renewability emphasised the naturally renewing energy of the sun, thereby demonstrating a sense that the renewable quality of both wind and water-power, despite their traditional use in the production of energy was recognised secondarily to other sources. In dealing with the subject matter therefore, it is necessary to detach from this contemporary conceptualisation which now understands wind and water-power singularly as sources of 'renewable' or 'alternative' energy, distinctly separate and othered to conventional methods derived from the burning of fossil fuels by means of their *renewability* as energy sources. By doing so, new histories of renewable energy can be revealed as the thesis seeks instead to explore discourses of naturally renewing sources of energy prior to the contemporary period in which these forms of electricity production are synonymous with ideas of 'renewability'. In this way, the thesis seeks to unearth the *pre*-histories of renewable energy.

This historical approach to the subject matter reinforces the epistemological stance of the thesis by challenging contemporary understandings of naturally renewing energy sources. Subsequently, the concept of renewable energy becomes problematised as it loses legitimacy when applied to earlier ideas of energy generation. Instead, a new way of seeing is required: individual manifestations and discourses of renewable energy are approached throughout the study as entities that reflect particular values and ideas about nature, landscape and technology specific to the era in which each developed. Concentrating on particular manifestations and discourses of renewable energy, these representations and the landscapes within which they are embedded are read as cultural and symbolic artefacts from which specific histories of energy generation can be extracted.

As a function of their purpose, structures of renewable energy connect with the components that make up the fabric of landscape. These edifices therefore become integrated elements and as such cannot be read in isolation from the landscapes in which they are embedded. Ultimately, by exploring historical meanings of renewable energy, the thesis reconstitutes understandings of landscape which continue to inform contemporary ideas of renewable energy and necessitates a re-reading of such structures and the landscapes in which they are situated.

By establishing both the *nature* and *scope* of renewable energy in Britain, the thesis seeks to explore alternative meanings of wind and water-power over the course of the study period (see chapter 2). The thesis explores the principle manifestations of renewable energy and examines the discourses surrounding these structures. From here, new readings of wind and water power are extracted to illustrate the symbolic nature of what is now conceptualised as 'renewable energy'. The thesis also examines how discourses of changing forms of energy production and hence new (and old) technologies reflected changing states of order over the course of the twentieth century. Similarly, through its approach to renewable energy the thesis explores the extent to which concepts of nature, environment and landscape altered and evolved over the period of study. Although the thesis detaches from late-twentieth century concepts of renewable energy, it remains mindful of contemporary ideas of landscapes of alternative power generation, informed as they are by ideas of nature, landscape and technology, and seeks to establish their historicity, whilst concurrently unearthing other unexplored historical meanings. In doing so, albeit secondarily, the thesis aims to contribute to contemporary discourses of renewable energy by reconstituting the way in which representations of renewable energy are conceptualised and thus evoking new symbolic meanings of renewable energy distinct to those by which they have come to be understood in the contemporary era. In its wider geographical context, the thesis aims to contribute to cultural, environmental and historical geographies articulated through notions of culture and nature.

1.1 Thesis Composition

1.1.1 Case Studies

Whilst particular examples of renewable energy in Britain over the course of the twentieth century have already been documented (as will be discussed in chapter 2), this thesis seeks to explore otherwise unexamined episodes in Britain's history of renewable energy, which have been unearthed in the process of retracing these histories. These new histories of renewable energy are explored through two substantive case studies.

Twentieth century discourses of landscape and technology have emphasised the notion of 'scale' as a means of exploring historical and cultural landscapes, especially in the consideration of 'landscape harmony'. Writing in the immediate post-war period, the landscape architect Sylvia Crowe argued that the development of 'large'-scale technological edifices, such as nuclear power stations, hydro-electric schemes and airfields, seen to be 'invading' the British countryside obstructed the natural rhythms of landscape order and harmony on grounds of scale (Crowe 1956; 1958). Crowe's work echoed the preservationist sensibilities expressed by (amongst others) the architect Clough Williams Ellis and town planner Patrick Abercrombie a quarter of a century earlier which during the inter-war period sought to preserve what were considered by some to be 'wilderness' landscapes and visions of Arcadia in the context of a burgeoning Suburbia and which sought to maintain the material and conceptual divisions between urban and rural landscapes (see Matless 1998). More explicitly, in the context of British landscapes of electricity generation, Bill Luckin (1990) documented how such preservationist ideas worked to challenge the construction of the National Grid between 1927 and 1934, given the unprecedented scale of electricity pylons proposed in otherwise 'domesticated' landscapes.

The relationship between technology, nature and landscape has also been considered in the context of American landscapes by authors such as Leo Marx (1964), Thomas Hughes (1989) and David Nye (1997; 1999), the latter in the context of the nineteenth and twentieth century electrification of the United States[1]. Despite the emphasis by such authors on the *social construction* of technological systems, ideas of scale remain implicit within such discourses, where large-scale edifices are seen as 'out of place' in 'pastoral' or 'wilderness' landscapes. More recently, comparable to the development of the National Grid in the inter-war period, notions of scale have been particularly prevalent to late twentieth and early twenty-first century discourses of landscape, technology and power in the context of renewable energy generation in the British Isles. Concerns over the 'industrialisation' of rural landscapes have featured as a significant factor in the public acceptance of windfarm construction (Blowers and Elliott 2003).

As will be demonstrated further in chapter 2, discourses of landscape, technology and power generation within cultural geography have hitherto concentrated on 'large'-scale edifices in the context of water, engineering and landscape. As a contribution to these debates and as a means of both unearthing and illustrating new meanings of landscape, technology and power-generation in the context of

[1] See 2.2.3 for further discussion of landscape, science and technology.

scale, the thesis concentrates on two examples of renewable energy generation which, by comparison, might be considered 'small'-scale. By focusing on these case studies, the thesis will draw out the idea of scale and its significance in terms of cultural geography discourses of landscape and technology.

i. Late-Nineteenth Century Hydro-Electric Power

The first case study focuses on hydro-electricity for public supply in late-nineteenth century Britain. Given the contemporary focus on renewable energy for public supply and the debates with which it is surrounded, the thesis seeks to explore their historicity by considering the very first examples which have hitherto remained relatively unexplored. These first engagements with renewable energy for public supply constituted small-scale hydro-electric stations, the first opening at Godalming in Surrey in 1881. Before the turn of the century fourteen further schemes were opened each varying in size, operating capacity, longevity and success. Building on technological and political developments of the preceding centuries these schemes were developed primarily for the provision of electric lighting as a more efficient and modernised alternative to gas. Compared to their successors, situated in remote landscapes distant from the towns and cities the supply for which they were developed, late-Victorian examples of hydro-electricity were predominantly located in villages and towns to supply these small centres and their hinterlands. The thesis will examine these examples of water-power in an attempt to explore English landscapes of hydro-electric power generation and reflect on late nineteenth century discourses of nature and modernity through engagements with applications of small-scale water-power technologies. Through this case study the thesis aims to build on previous research by the historical and cultural geographers Hayden Lorimer, Pyrs Gruffudd and Owen Roberts who have provided substantive cultural and environmental histories of hydro-electric power in Scotland and Wales (Gruffudd 1990; Lorimer 1997; Roberts 2006), through uncovering corresponding English discourses and in doing so contributing to wider cultural and environmental histories of water-power in Britain.

ii. The Centre for Alternative Technology

The Centre for Alternative Technology constitutes the subject of the second case study. Instituted during the early 1970s, exploring 'alternative' technologies as a means to self-sufficiency, it is during this period and through these counter-cultural engagements with 'alternative' versions of energy technologies that notions of 'renewability' in the context of energy generation emerge. Located in mid-Wales, CAT's innovative and pioneering working exhibition of self-sufficiency included demonstrations of small-scale wind, water and solar power technologies. Given the aim of the thesis to explore the *pre*-histories of renewable energy, the origins of these meanings which bear relevance to contemporary understandings of energy generation prior to their transition to conventional political and cultural arenas is both worthy of academic inquiry and fertile in further exploring notions of culture, nature and technology.

My interest lies primarily in the environmental visions that fostered these particular engagements with nature, landscape and technology. The foci of these two case studies therefore lie on the formative years of these respective engagements with renewable energy. Examining the unique environmental, political and cultural sensibilities through which they emerged offers the opportunity to explore late nineteenth and early twentieth century landscapes of alternative power generation and the interconnections between different historical discourses of small-scale renewable energy technologies over the course of the period of study which have hitherto remained conspicuously absent from wider geographical literatures, but which provide useful and unique opportunities for further exploration of the notions of energy and landscape. Through exploring these two case studies in a context in which discourses of renewable energy have hitherto emphasised large-scale visions of water-power, the thesis will instead draw out small-scale, and in the case of late-nineteenth century hydro-electric development, *civic* geographies of renewable energy.

1.1.2 Structure

The thesis is divided into three separate parts. Part I of the thesis continues with chapter 2 which comprises a review of the theoretical, empirical and contextual engagements with the subject matter to which a broad range of material has contributed. The focus of the study lies at the intersection of several areas of literature from within and beyond geography, also incorporating literature from the fields of history, engineering and the wider social sciences. In dealing with each collection of material the chapter considers its contribution to the development of the thesis. By way of demonstrating a comprehensive approach to the subject matter, chapter 3 provides a historical survey of the principal examples of renewable energy in Britain during the period of study as well as delineating the methodological approaches employed during the research process and the sources to which they were applied.

The following four chapters will address the substantive findings of the thesis organised according to the two case studies introduced above. Both of these research agendas draw out and are distinguished by distinct meanings of and engagements with renewable energy over the period of study. Part II, over two separate chapters, traces the history of thirteen of the first fifteen hydro-electric schemes for public supply in Britain which opened between 1881 and 1900. Chapter 4 firstly considers the contextual history of the development of hydro-electricity for public supply in the late nineteenth century charting the technological, socio-economic, cultural and political developments that facilitated these first engagements with renewable energy. This is followed by the chronological history of the development of twelve of the first fifteen stations. Chapter 5 then provides a more detailed exploration of Britain's largest hydro-electric station for public supply before the turn of the twentieth century, opened in Worcester in 1894.

Part III of the thesis charts the development of the Centre for Alternative Technology. In a discussion centred on ideas of 'alternativeness' in the context of both culture and technology the activities and ideologies of a particular counter-cultural movement mobilised around alternative visions of environment, society and technology are traced. Chapter 6 begins with a consideration of the political, social and cultural context to the initiation of the CAT project outlining an emerging counter-cultural ideology which fostered new theoretical and practical engagements with alternative notions of environment, society and technology from the late 1960s, in the context of contemporary ideas of energy. This is followed by the consideration of the period during which the project was instituted including an examination of the biography of its founder, the wider landscape within which the project was located and the specific planning framework which facilitated its development. Chapter 7 then focuses more specifically on the chronological evolution and working of the Centre during the early to late 1970s. Adopting a thematic approach, the chapter explores how the Centre functioned through considerations of its ideological, philosophical and practical expressions of alternative visions of technology and society, concluding with the subsequent activities of the centre and its wider legacy within local and national cultural and political spheres.

Through a comparative exploration of the case studies examined, chapter 8 attempts to draw out some general conclusions and make some wider statements about the cultural and historical geographies of renewable energy in twentieth century Britain and connect the findings with contemporary notions of landscape, technology and sustainability. Through a reflection on its contribution to geographical discourses of nature and landscape the thesis is repositioned in its wider academic context.

2 Investigating Landscapes of Power

This chapter considers theoretical engagements with notions of energy and landscape. By way of introducing these ideas, this section provides brief analyses of two primary sources concerned with alternative twentieth century visions of renewable energy. This is followed by a discussion of the key literatures from within Geography and elsewhere that have informed both the theoretical construction and methodological approach to the thesis.

2.1 The Cultural and Historical Geographies of Renewable Energy and Landscape

Ideas about energy and landscape, given their relevance to an array of disciplinary fields have been articulated most notably within the academic arena of engineering (Carter 1960; Cantor 1963) encompassing its related field of industrial archaeology, which has focused on the technologies of energy generators (primarily hydro-electric stations) from a historical perspective (Strange 1979; Tucker 1979; Tucker 1980; Woodward 1998) and also the aesthetic value of windmills and watermills within landscape (Finch 1933b; Syson 1965; Hopkins 1976; Wailes 1979; Syson 1980; Major 1986; Wenham 1989; Watts 2000; Watts 2002). Considering windmills and watermills, such structures have also featured significantly within local history publications (Gifford 1999), studies in 'the picturesque' (Hopkins 1976; Major and Watts

1977) and regional landscape histories (Williamson 1997). Elsewhere, ideas of landscape and energy have been the subject of economic and environmental histories, also featuring within discourses of architecture and landscape design (Crowe 1956; Crowe 1958; Payne 1988; Luckin 1990). However, within the field of cultural and historical geography, the subject of landscape and energy, particularly that which constitutes renewable energy, is a relatively neglected area of intellectual enquiry. Where these subjects have been addressed, geographers have tended to consider large-scale water-power schemes, specifically hydro-electric power generation, which have featured as engagements with landscape through which wider cultural politics have been articulated (see Gruffudd 1990; Lorimer 1997 and Roberts 2006). Further examples of renewable energy have remained intriguingly devoid of scholarly interest from within the tradition of cultural and historical geography.

Given a dearth of attention to the specific subject matter, a broader body of literature from within cultural and historical geography is explored as the literature which informs the thesis. Not only does this area bear relevance to discourses of water, landscape and power it also comprises the disciplinary field into which the thesis seeks to situate itself. This material is categorised here as 'water, engineering and landscape' after Cosgrove and Petts' (1990) same titled text which sought to address the complex interactions between the three elements and reiterated the need for an interdisciplinary approach to the natural environment and human agency. In doing so Cosgrove and Petts (1990) established a broader research agenda for the study of the interactions between water, engineering and landscape, which by virtue of its pertinence to each of these elements, includes engagements with renewable energies.

Before attending to this material however, by way of introducing twentieth century discourses of landscape, water and power, the section begins by providing two examples of the way in which ideas about renewable energy and landscape have been articulated during the period in which the thesis is interested; examples which also connect to themes explored in the empirical chapters of the thesis. As stated above, two primary sources are examined to illustrate competing twentieth century notions of landscape, water and energy through two contrasting applications of water-power. These examples serve to illustrate not only the variation in modes of renewable energy during the twentieth century, specifically water-power, but also the contrasting and sometimes conflicting ideologies to which these versions of water-power connect and from which corresponding environmental visions are drawn.

2.1.1 The Severn Barrage: Water-Power and the Re-imagination of a Region

In August 1924, the *Illustrated London News*, a weekly graphic journal reported on the announcement by Philip Snowden, then Chancellor of the Exchequer of the first Labour Government, of a £95,000 budget to investigate the technical and commercial feasibility of a tidal barrage across the Severn Estuary. The article was accompanied by a full page illustration of an artist's impression of the way in which such a structure and its place in the wider region of the Severn Estuary was envisaged (see figure 2.1.1). Consideration of this image serves to convey a particular vision of landscape and water-power in the early twentieth century, one which as will be demonstrated in 3.1, was realised in British landscapes during the inter- and post war eras. This particular notion of water-power in the immediate post-First World War period worked to re-imagine an economically ailing and depressed region of Britain which was envisioned not only as geographically marginal but also with a regional identity of which particular elements connected to environmental visions of heavy industry, dirt and ill-health (Linehan 2003a).

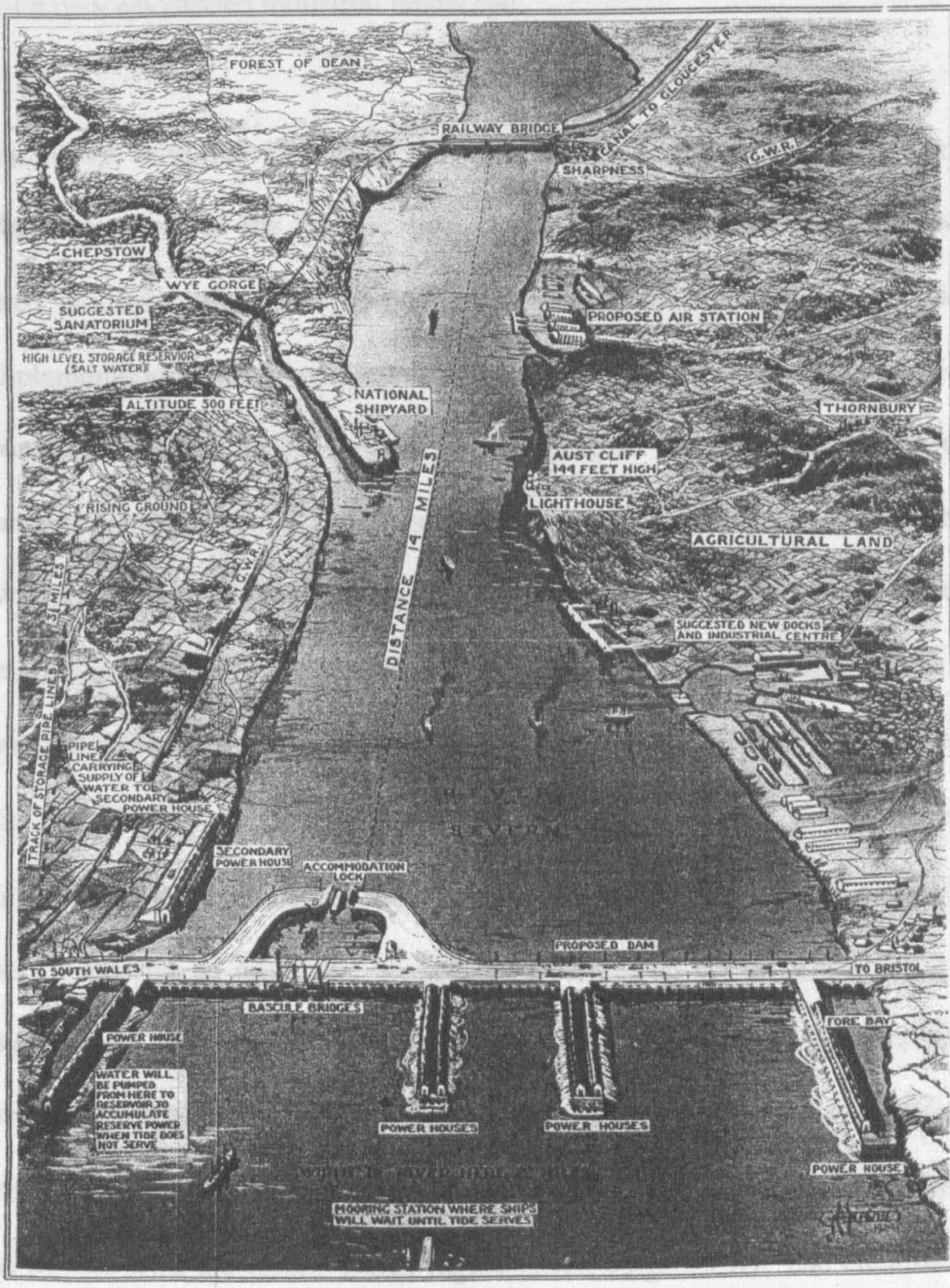
The development was initially articulated in an interim report by the Ministry of Transport in 1920 which arose out of the Water Power Resources Committee appointed by David Lloyd George's Government in 1918. At fifty feet, the Severn had one of the largest tidal ranges in the world harbouring an equally sizeable source of natural energy and was consequently expected to generate up to 1.5 billion kilowatts a year to supply industrial, commercial and residential interests to an area within a 30-mile radius of the structure, which the accompanying article boasted was "more than was supplied last year by all the London public authorities and companies and the seven largest electricity power stations in the country outside the Metropolitan area" (Liversedge 1924). The proposed structure was to span a 2-mile width of the river from a point near Sudbrook in Monmouthshire on its northern shore to one near Redwick in Gloucestershire on its southern bank.

Central to the image is the vast River Severn and the tidal barrage spanning its width, depicted in minute detail as the focus for the illustration. In addition to the superstructure, various industrial interests are proposed along the banks of estuary upstream of the barrage including an air station, a vast port, a national shipyard, agricultural land, new transport infrastructures and significantly an 'industrial centre'. The centrality of the Severn in the image is significant: rather than seeing the Estuary as a divisive barrier to the adjacent regions of South Wales and south-west England it is re-imagined as the central, common feature, bringing two previously geographically separated regions together to form a reconfigured space. The way the image cuts across these pre-defined regional divisions to create a new regional geography of England and Wales echoes the work of the early twentieth century regional geographer Charles Bungay Fawcett, who in 1919 first published ideas about the reconfiguration of the provinces as a means of decentralised political governance, proposing the Bristol Province to include the districts surrounding the Severn Estuary as a more natural region based on geography and English social life[1].

[1] Fawcett (1919) also suggest the Severn Province (what is perhaps now known as the West Midlands), which was further north and named after its principal river.

HARNESSING THE TIDE FOR ELECTRICITY: A UNIQUE POWER SCHEME.

PICTORIAL DIAGRAM DRAWN BY OUR SPECIAL ARTIST, G. H. DAVIS, FROM MATERIAL SUPPLIED BY MR. A. J. LIVERSEDGE, A.M.I.C.E.



THE LONGEST EVER DEVISED, AND ABLE TO SUPPLY ELECTRIC POWER TO ALL LONDON AND THE NEXT FIVE BIGGEST TOWNS: A PROJECTED BARRAGE (AND BRIDGE) ACROSS THE SEVERN, WHICH HAS THE THIRD HIGHEST TIDE IN THE WORLD.

Figure 2.1.1 'Pictorial diagram' by 'special artist' G.H. Davis of the proposed Severn Barrage based on material provided by author of the accompanying article A.J. Liversedge, A.M.I.C.E.

Source: *Illustrated London News*, 30th August 1924

Like the author of the image in figure 2.1.1, Fawcett (1919) imagined the Severn Estuary as the core of the new region drawing spaces together rather than working as a divisive topographical feature. The banks of the Severn were thus being re-envisioned as a new industrial centre, the river serving as a central focus at the heart of a new envisioned industrial landscape.

Moving away from the centre of the image, the depiction of the Severn's hinterland reveals that the broader project also worked to connect the newly imagined industrial centre to wider regional geographies through the extension and implementation of new communications infrastructures as new and existing rail, road, canal, river and sea routes are suggested. Through research on the economic geographies of South Wales, Denis Linehan has argued that during the inter-war period the region became politically constructed as a spatially peripheral and marginalised space, a geographical vision of the region which worked to reinforce the process of economic and industrial decay (Linehan 2003a; Linehan 2003b). The creation of a vast shipping port and harbour served by the national shipyard would serve industrial and shipping interests within and beyond the national boundaries as might the proposed air station on the estuary's southern bank near Aust Cliff. In addition to a tidal power generator it was proposed that the barrage would also provide an additional means of rail communication to the existing Severn Tunnel, a service which was then considered "greatly congested" linking Bristol with the South Wales region (Liversedge 1924). The creation of these new communication networks thus worked to address both the perceived and material marginality of South Wales and the English counties bordering the Estuary. Not only did this attempt to reconfigure the region in the public imagination as more accessible, it also worked to suppose it as metaphorically if not geographically closer to the nation's economic capital therefore reconstructing the region's imagined peripherality.

As a further dimension to the story of the Severn Barrage in 1920s, the industrialisation of the banks of the Severn estuary can be partially understood in relation to the economic conditions of South Wales which the image does not show but the economic regional geography of which at this point in time bears relevance. By the end of the First World War, South Wales was suffering widespread economic depression as a result of the decline of its primary industrial base during the early twentieth century. Increased international competition had reduced the demand for exported coal, the effects of which began to be felt once the aftermath of war had subsided and the inescapable problem of excess capacity caused by a growth in competition and a deceleration in demand had become a reality (Supple 1987). The expression of that reality was devastating mass unemployment. A tidal barrage across the Severn therefore worked to address these economic and industrial conditions. In addition to the provision of enormous employment opportunities through the construction of the vast scheme (a central aspect of the Ministry of Transport's 1920 interim report) and through the provision of what was heralded as a 'cheap' power supply the scheme sought to *promote* industrialism along the Severn's banks as depicted in the illustration, thus serving to re-invigorate the decaying industrial base of South Wales and the Severn's English bordering counties.

The image also works to re-imagine the region through reconstructing ideas about the area's regional identity. This again bears particular relevance to that of South Wales, which during the inter-war period was intimately connected to ideas of heavy industry, air pollution and dirt (Linehan 2003a). Proposed new features depicted in figure 2.1.1 worked to move the identity of the region away from these ideas, instead connecting it to notions of cleanliness, purity, Nature, health and leisure. This is achieved primarily through the assumed reduction in the burning of coal through the generation of electricity by water, a source that was symbolic of cleanliness and hygiene at a time when environmental concerns over clean air and public health abounded[2]. In addition to the water-power structure, a salt-water reservoir is depicted above the banks of the estuary, which would serve as both a 'suggested sanatorium' and "paradise for the sea angler" (Liversedge 1924). These new health and leisure amenities in addition to notions of 'purity' and 'clean power' thus work to move the identity of the region away from its industrial past and instead connect it with ideas of modernity and cleanliness. This new industrial regional identity also incorporated agricultural production, which was repositioned as a transitional space between the rural hinterland and the urban industrial zone.

This visual representation of the Severn Barrage thus worked to re-imagine the Severn and its hinterlands as a modern industrial landscape powered by a clean energy supply and accessible by all forms of industrial transport, through reconfiguring ideas of industrialism, geographical marginality and regional identity. More than just an electricity generation scheme, the vast civil engineering project therefore linked early twentieth century visions of water-power to regional planning and economic reconstruction and an environmental vision which embraced notions of 'progress' and modernisation. However, competing ideologies sought to counteract these ideas; a way of relating to the world which could also be channelled through visions of water-power,

[2] The Public Health (Smoke Abatement) Act was passed in 1926.

specifically watermills, but which instead looked to the past as a way of moving forward.

2.1.2 'Rogers of Frome and Stour': Water-Power and the Revival of the 'English Cultural Tradition'

In 1946, the British 'ruralist' writer H. J. Massingham published *Where Man Belongs*. The text was essentially a critique of what Massingham viewed as an increasingly industrialised and subsequently degraded social order through a call for the revival of the 'English cultural tradition' (Abelson 1988; Brace 1999; Moore-Colyer 2002). Focusing on a particular individual, each chapter of the book explores a different aspect of this tradition. The front cover of *Where Man Belongs* (see figure 2.1.2) depicts a typical English village scene replete with village church, thatched cottages and cobbled streets; a pictorial representation of the kind of Arcadian, pre-industrial tradition Massingham sought to reinstate. This particular way of life is alluded to in the ninth chapter of the book, entitled 'Rogers of Frome and Stour', which focuses on the case of millwright Frank Rogers, whose life and work is related through the chapter in part through a series of correspondences with Massingham. Throughout the course of the chapter the declining rural practice of millwrighting is used as an allegory to resist the corresponding decline of a particular rural way of life which Massingham through reference to a reinstatement of particular versions of craftsmanship (here millwrighting) seeks to revive.

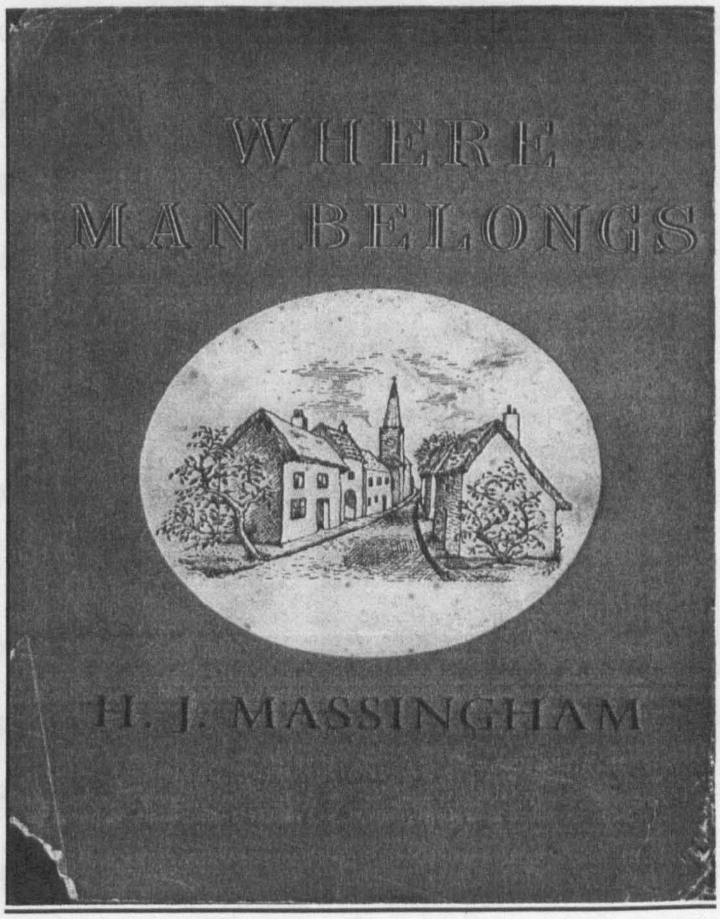


Figure 2.1.2 Front Cover of H.J. Massingham's 1946 text *Where Man Belongs*
Source: Author's photograph

Born in 1888 into a family of Norfolk non-conformists, by the 1940s, the decade during which the text was published, Massingham had become a life-long campaigner for the rural way of life which he saw as threatened by industrial mass production a subject on which he had published prolifically. Through these writings, not least in 'Rogers of Frome and Stour' a wider ecological consciousness emerges which is characterised by an organicist, localist sensibility which is anti-industrial, anti-technological and which correspondingly values manual skills and small-scale production systems.

Through their lamentations of the decline of millwrighting Massingham and Rogers allude to the corresponding decline and subsequent dereliction of the watermill, increasingly witnessed throughout rural communities since the eighteenth century as a result of the introduction of more mechanised processes brought about by the industrial revolution (Finch 1933a; Wailes 1979). This narrative is worked through a series of recurrent themes, notably ideas about the rhythms of Nature and those about manual work and the body, each of which were invoked through engagement with the watermill. On his reflections of Rogers' letters, of two of Rogers' colleagues Massingham writes: "Parsons and Billy seem to have kept the whole small and active rural community, revolving like a wheel round the hub of the mill, in running order" (Massingham 1946: 191). Massingham uses the idea of the maintenance of the watermill and its subsequent ability to drive small communities as a metaphor for a more 'natural' order, one which reflects the rhythms of Nature. This idea of the watermill as the driving force of the local community is revisited in the concluding paragraphs of the chapter where Massingham describes how "when the water-mills went derelict, the parish community was dislocated and the economy of centuries disrupted. It was as though the linch-pin [*sic.*] had been removed from the wheel of rural self-maintenance" (*ibid*: 210). For Massingham there is an interdependency and integration between the mill and the community, its functioning necessary to the community's orderly working, comparable to the interconnectedness of 'natural' habitats.

Massingham's nostalgic call for a return to a past way of life is also communicated through his ideas about work and the body. For Massingham, putting something of oneself into one's work is to be valued and true craftsmanship entails some evidence of toil on the body. Massingham cites Frank Rogers' account of one of his colleagues, Billy, whom Rogers describes as,

> of a jolly disposition, never seemed ruffled come what may and with a rosy complexion. His frame was the only index to years of toil, with a gait of walking with one shoulder higher than the other, medium height, a good memory for the events that had taken place during an active life in the occupation of milling. Anyone looking at the splendid country type of face in that lovable [*sic.*] character would observe tattoo-like pock-marks of blue, indicating fragments of steel. The application of the mill-bill not only played the backs of his fingers but the fragments had penetrated the sides of his nose (*ibid*: 189).

The idea conveyed is the craftsman as wholly integrated with his craft; inseparable from his work; the evidence of his work ingrained upon his physical being and the craftsman's toil and passion, himself reflected in his work. But what is also conveyed is perhaps the *pre*-occupation of the millwright with his work: in this respect, the idea of the craft not as an 'occupation', but as part of and necessary to existence. Massingham comments on the absorption of Rogers in his work when recounting his past practices: "the correspondent gets lost in his lovingly elaborated description of the water-powered machinery of Factory Mill" (*ibid*: 190). What was once work, later in life becomes leisure; a comment on the status of craftsmanship. According to the nineteenth century social commentator William Morris craftsmanship could be differentiated from a sense of 'work' as a pleasurable and worthwhile activity, a sentiment echoed by Massingham in his correspondences with Franks Rogers (Harrod 1999). The practice of millwrighting as a form of craftsmanship for Massingham represented a connection to small-scale production, manual labour and low level technology. These practices were thus antithetical to the large-scale mass production systems, mechanisation and technological modernisation of the 'modern age' that Massingham sought to resist; a sentiment which he channelled through a wider anti-technological spirit. Through Massingham's metaphorical use of notions of wheat and bread, his sensibility also worked through what might be considered an 'organicist' sentiment which sought to reinstate the bonds between humanity and nature and which connected to notions of the national body (Matless 1998; Matless 2001).

To Massingham the decline of the watermill and its associated rural practices was a threat to the traditional English cultural identity. The usage of Massingham's book chapter thus demonstrates how alternative versions of water-power, here the watermill, connect to a wider set of ethics which comply with a particular ecological consciousness. The loss of rural crafts such as millwrighting is used as a metaphor for a particular set of values which lament the decline of a wider English cultural tradition and thus the erosion of a particular view of national English identity; one rooted in rural life, itself the embodiment of small-scale production systems and closer engagement with nature.

The use of these primary sources, the first demonstrating how ideas about water-power in the early inter-war period connected to wider State concerns over regional regeneration and the second, conveying a nostalgic desire for a return to a bygone era, provide a useful contrast and both open up a series of questions about the wider cultural and environmental associations of renewable energy during the period of interest, questions that are further traced through the literatures explored below.

2.2 Geographical Discourses of Water, Engineering and Landscape

Theoretical explorations of renewable energy and landscape from within cultural and historical geography have hitherto emphasised large-scale hydro-electric generation schemes. As such the literature considered here focuses on this material which features as part of a broader disciplinary trend which explores large-scale water-engineering projects and landscape. Considering theoretical engagements with water-engineering and landscape since the eighteenth century, this section of the chapter draws on a body of literature which as outlined earlier in the chapter has been collectively categorised as 'water, engineering and landscape'. Drawing on material predominantly by Geographers but also social and engineering historians, considerations of water-engineering projects predominantly in Britain but also in the United States and Germany are explored. Rather than provide a comprehensive review, this section adopts a thematic approach to the material and works instead to draw out the emergent themes from this body of literature to which the thesis pertains.

The primary focus of the literature is concerned with large-scale water-engineering developments primarily in Britain paying close attention to projects in the country's upland landscapes most notably the Scottish Highlands, the Welsh mountains and the Peak District. Such developments include hydro-electric schemes, which witnessed several phases of development in the uplands of

Scotland and Wales during the inter- and post-war eras and reservoir construction which was practiced most notably in the Welsh hills in the late-eighteenth century and the post-Second World War period but which was also witnessed in the regions of Britain in the inter- and post war period (Gruffudd 1990; Cosgrove et al. 1996; Lorimer 1997; Roberts 2006). Gruffudd (1990) and Roberts (2006) have considered large-scale water-engineering projects in the hills and mountains of Wales. Pyrs Gruffudd has explored inter- and post-war engagements with hydro-electric power in relation to contemporary Welsh politics, whereas Roberts has paid greater attention to large-scale reservoir schemes in the late-nineteenth and mid-twentieth century to explore more specifically notions of English 'neo-imperialism'. Building on Gruffudd's work Hayden Lorimer (1997) has addressed the implication of hydro-electric debates in relation to Scottish cultural politics in the inter-war period, while Cosgrove et al. (1996) have instead focused on the role of reservoir development in the Peak District and Rutland to explore cultural constructs of national English identity. However, what might be considered small-scale 'soft' water-engineering endeavours have also been attended to in their relation to landscape through discussions of eighteenth and nineteenth century alterations to canals and rivers (Daniels 2005; Revill 2007). These debates also extend to projects realised in Germany and the United States in the first half of the twentieth century, in particular reflections on the construction of the Panama Canal and the development of the Tennessee Valley Authority (TVA) which are brought together here to explore ideas about water, landscape and engineering (Huxley 1943; Lilienthal 1944; Clapp 1955; Kyle 1958; Matless 1992; Hargrove 1994; Black 2002; Blackbourn 2006).

Within these texts a set of common themes emerge regarding ideas about the conquest of Nature, the ordering of landscape and landscape harmony, regional economic regeneration, the national body and nationhood and sovereignty. These themes are considered here as constituents of two broader headings; 'water-engineering, landscape and modernisation' and 'landscape and national identity'.

2.2.1 Water-Engineering, Landscape and Modernisation

Discourses of water, landscape and engineering within Geography and elsewhere demonstrate how large-scale water-engineering projects since the late eighteenth century are underpinned by notions of 'modernisation'. Theoretical engagements with such structures have shown that through not only the *aesthetic* but also the *moral* ordering and systematisation of landscape, a sense of landscape harmony can be achieved, a notion that has been explored in depth in relation to structures of energy generation elsewhere by the landscape architect Sylvia Crowe (1958). Studies of the building of the Tennessee Valley Authority's hydro-electric schemes and post-war developments of reservoirs in England have shown that this particular notion was especially pertinent through the application of a modernist design aesthetic which held ideas of landscape harmony at its core (Clapp 1955; Kyle 1958; Cosgrove et al. 1996; Black 2002). Elsewhere, studies of water-engineering and landscape have shown that the construction of such structures connects to notions of modernisation through the wider pursuit of regional economic regeneration and ideas of both landscape and civic 'improvement' (Huxley 1943; Clapp 1955; Hargrove 1994; Lorimer 1997; Daniels 2005; Roberts

2006; Revill 2007). These themes and notions are explored in greater detail below.

i. The Conquest of Nature

What is implicit within these formulations of landscape is a particular vision of Nature. Large-scale water-engineering projects have been focused on to examine notions of 'the conquest of nature' as David Blackbourn (2006) entitles his exploration of engagements with water-engineering projects and their role in the evolution of the modern German state (Cosgrove and Petts 1990b; Cosgrove and Petts 1990a; Gruffudd 1990; Cosgrove *et al.* 1996; Black 2002; Daniels 2005; Blackbourn 2006). This evaluation of Nature also emerges through considerations of large-scale water-engineering projects in British landscapes and elsewhere. In dealing with the introductory themes of water, engineering and landscape, from a perspective grounded in cultural and historical geography, Cosgrove (1990) argues that the twentieth century witnessed a "triumphalist age of apparent mastery over nature" (1990: 1). Twentieth century ideas about the management of water and landscape through large-scale engineering were borne out of new ways of conceptualising nature, which Cosgrove *et al.* (1996) have suggested stemmed from the Victorian vision of culture-nature relations. Over the course of the twentieth century water especially came to be perceived as a resource to be managed which was often imagined as pouring wastefully into the oceans (Gruffudd 1990). However, this idea about the aesthetic and economic efficiency of landscape as George Revill (2007) has shown was evidently anticipated much earlier in eighteenth century water-engineering practices. In his study of the eminent civil-engineer William Jessop and his 'improvement' of the River Trent, Revill shows how such practices sought to harness an otherwise 'volatile' force: through 'guided self-regulation' "Jessop was able to convert volatile energy into a force for stability" (Revill 2007: 209).

This conceptualisation of Nature was part of a wider quest to make landscape 'useful' as over the course of the eighteenth, nineteenth and twentieth centuries Nature became imagined as a resource to be exploited for the benefit and progression of humanity. In reference to engagements with water-engineering and landscape prior to the twentieth century commentators refer to the conversion of otherwise idle tracts of landscape to 'useful' spaces (Daniels 2005; Roberts 2006; Revill 2007). By the turn of the twentieth century nature was being increasingly evaluated in terms of its utility to humanity. The prevailing notion is one of the 'taming' of nature, a narrative that can be found riddled throughout discourses of water, engineering and landscape.

This theme is also drawn out by Pyrs Gruffudd (1990) and in his study of hydro-electric development and nationhood in inter-war Wales is found to be clearly at play within Welsh hydro-electricity debates. Gruffudd illustrates this idea with an extract from the architect Clough Williams-Ellis' text *Headlong Down the Years* (Williams-Ellis and Williams-Ellis 1951). Although it can be argued that Williams-Ellis displayed a modernist sensibility in his architecture, this fictional account of hydro-electric power development in the Welsh uplands critiqued this approach to managing the landscape on which his preservationist sensibilities were brought to bear.

> Here is a stream … rushing down through a thick, intricate, wood – here the whole body of waters bursts foaming out from among the trees and tumbles wastefully down the cliff. But here is the place corrected! The wood is cleared, the entire stream runs usefully through a pipe, and turns the great wheels of the tremendous Power House that you see below (Williams-Ellis and Williams-Ellis, 1951: 23 in Gruffudd, 1990).

Headlong Down the Years used as its model Thomas Love Peacock's *Headlong Hall* (1816) an attack on eighteenth century landscape 'improvement', clearly evoking ideas not only of *controlling*, but also of *ordering* nature and landscape.

ii. The Ordering of Landscape

This way of seeing Nature was reflected in landscape practices through the rhetoric of 'order', regulation and systematisation which connected the aesthetic dimension of landscape to wider social, political and economic modernising mechanisms (Cosgrove and Petts 1990b; Cosgrove and Petts 1990a; Gruffudd 1990; Cosgrove et al. 1996; Black 2002; Revill 2007). In their exploration of landscape and identity Cosgrove *et al.* (1996) assert that such notions of nature and landscape were reflected in large-scale water engineering developments at Ladybower Reservoir and Rutland Water (constructed 1935-45 and 1968-76 respectively). Cosgrove *et al.* describe how the surrounding landscapes of both projects underwent physical and ecological alterations. For example, the surrounding landscape of Ladybower Dam was transformed from a remote upland moorland; an unordered landscape but one which reflected the interaction between nature and people through game management and agriculture, to an organised, regimented landscape, characterised by systematic construction and planting.

These ideas about nature were also brought to bear on projects realised in the United States in the 1930s, notably the Tennessee Valley Authority development which oversaw an entire region of hydro-electric power development, encompassing a co-ordinated series of dams, and tunnels, rivers and lakes, connected by a network of electricity pylons. Describing the scene, David Lilienthal writes:

> There it is, stretching out before your eyes, a moving and exciting picture. You can see the undulation of neatly terraced hillsides, newly contrived to make the beating rains 'walk, not run, to the nearest exit' ... And marching toward every point on the horizon you can see the steel crisscross of electric transmission towers (Lilienthal 1977: 8-9 in Black 2002: 157).

Again, the idea of the need to control nature emerges. However the emphasis here is on the sense of an organised landscape. In his study of landscape management and regional planning in the context of the TVA, Black (2002) affirms that the development of the TVA can be understood as a physical expression of a new, 'modern' era in conservation thinking, a new reasoning encompassing a desire to organise and systematise the natural environment, for the purposes of improving the management and organisation of nature seen as unruly and out of control. For Black the TVA was a model of 'instrumentalized nature' transposed onto the wider landscape as an alternative approach to landscape planning and modernisation which embodied the principles of order, control and regulation.

This ordering of landscape was not only concerned with the regulation of Nature. Water-engineering projects in various forms have also been explored as a means of ordering those that inhabit landscape through what might be considered 'geographies of displacement'. This has been most notably discussed within the literature by Owen Roberts (2006) in his consideration of late-nineteenth century reservoir development in the Welsh mountains which witnessed the drowning of the Vrnwy and Elan Valleys for the municipal provision of drinking water for the growing urban populaces of Liverpool and Birmingham and the subsequent displacement and relocation of entire communities. In the same paper Roberts (2006) shows how this theme re-emerged in the immediate post-war period when in 1956 concerns over the adequacy of Vrnwy resulted in a proposal by the Liverpool Corporation to dam the Tryweryn River[3].

For Revill (2007) however, the ordering of people in the landscape through water-engineering schemes was a more obvious practice, demonstrating how the modernisation of landscape through water-engineering contributed to landscape as a mode of governance. In a paper on the eighteenth century civil engineer William Jessop and work on the River Trent, Revill shows how water-engineering "participated in the practices and processes by which landscape functioned as a mode of governance within the context of eighteenth century improvement" (Revill 2007: 211). Revill argued that Jessop's regulation of the river "would order the landscape by removing the twin threats of a volatile river and vagrant labour" which was seen to encroach onto adjoining agricultural land when towing

[3] It is interesting to note that both Ladybower Reservoir and Rutland Water entailed the submergence of valleys taking with them community land although Cosgrove et al. (1996) pay little attention to this practice of displacement.

was done by hand (*ibid.*). As a means of ordering both landscape and its inhabitants, engineering improvements to the River Trent had the following result: "turbulent stream to calm navigation, inundated floodplain to controlled productive meadow and unruly dissolute crowd to compliant labour force" (Revill 2007: 212).

iii. Landscape Harmony and Modernistic Design

The systematisation of landscape implicitly embodies ideas about landscape harmony. The inter- and post war period witnessed a new form of water-engineering which proposed large-scale bold and imposing structures such as dams, reservoirs and large-scale hydro-electric schemes often in what were perceived as 'traditional' landscapes, structures were often informed by new modernistic design principles (Crowe 1958; Cosgrove and Petts 1990b; Cosgrove and Petts 1990a; Gruffudd 1990; Matless 1992; Cosgrove et al. 1996; Black 2002; Roberts 2006). Although the modernisation of landscape embodied ideas of order and organisation, they also deferred to ideas of *harmony* within landscape, an overriding objective at the centre of modernistic design. Cosgrove *et al.* (1996) suggest that modernist sensibilities were particularly expressive during the middle years of the twentieth century which "witnessed a greater acceptance of modern interventions to engineer progress, so long as modernity could be integrated into the perceived existing landscape order" (ibid: 536). Inherent in the authors' statement is the defining sentiment of modernistic design which expressed the sentiment that through order, harmony could be achieved. These ideas of harmony extended to building(s) in the landscape which also sought to achieve a state of order, which in the context of the TVA, Julian Huxley (1943) observed should "form a unity with the landscape and enhance its interest and beauty" and express "the order, amenities, and beauty that characterise a well-functioning society" (Huxley 1943: 74).

This emerging design ethos which was reflected in water-engineering schemes such as Ladybower Dam, Rutland Water and the hydro-electric schemes realised in Scotland and Wales in the inter- and post period was however perceived as incongruent with 'natural' landscapes. Modernist architecture applied to the design of dams, reservoirs, tunnels and buildings of hydro-electric power stations was bold and unapologetic in its sheer size and presence, and was perceived by many rather than in harmony, as unsympathetic to nature and landscape. Correspondingly, "The modernist engineering aesthetic ... did not find enthusiastic support in Britain" (Cosgrove *et al.* 1996: 548).

However, the proponents of this set of emerging design principles stated that on the contrary, modernistic design could achieve a feeling of harmony with landscape. Modern architecture encompassed the maxims 'form follows function' and 'fitness for purpose'. The idea of these design mantras was the incorporation of simplicity and control within structures and the integration of those structures into the surrounding landscape to achieve a sense of proportion. This law drew on the cultural authority of the European fathers of modern architecture and extended to all elements of engineering design. Cosgrove *et al.* (1996) describe how the interior workings of Ladybower Dam captured "the modernist engineering spirit and aesthetics, adopting the forms of factory interiors and the steel construction principles illustrated in publications by Le Corbusier and Walter Gropius" (*ibid.*: 538).

Through the application of mathematical theory, posited by modernists as a 'natural' law, proponents of modernist design argued that a feeling of harmony between the structures and the landscapes in which they were proposed could be achieved, because this style of design drew on nature *itself.* Employing "severe mathematical precision, in which form follows function and where materials and structures are revealed to the gaze honestly and without decoration" (Cosgrove *et al.* 1996: 548), in its strictest form modernistic design was seen as discordant to the traditional buildings architecture of past centuries with its intricate styles and elaborate and decorative motifs. However, Matless *et al.* (2003) assert that modern design rather than rejecting the past *per se*, "constructed different traditions from which to oppose traditionalism" (*Ibid*: 250). In their reading of landscape and identity at Ladybower Dam and Rutland Water, Cosgrove *et al.* (1996) state that the chief engineer applied Le Corbusier's modernist maxim to the design, materials and landscaping of the project: "Our engineers ... employ a mathematical calculation which derives from natural law, and their works give us the feeling of HARMONY" (Le Corbusier, 1927: 19 in Cosgrove *et al.* 1996: 540). The work of the engineers at Ladybower contributed to the idea of a civilised and harmonious world, whilst at the same time creating an expression of the 'natural' laws of proportion so valued by modernism. Ladybower achieved this balance between progress and preservation through the incorporation of local materials and attention paid to the contours of the existing landscape.

The extent to which structures were seen to harmonise with landscape was often related to ideas of scale, an element of modernist design widely articulated in the literature (see Black 2002; Gruffudd 1990; Crowe 1956; 1958). Sylvia Crowe was a leading authority in Landscape Architecture and published two books on the subject in which the relationship between scale and ideas of landscape harmony were explored (see Crowe 1956; 1958). Crowe suggested that perceptions of harmonised landscape were ultimately related to the capacity of a region to accommodate such projects. Taking the examples of Ladybower Dam and Rutland Water (a project on which Sylvia Crowe was employed as Landscape Architect), Cosgrove *et al.* (1996) argue that the wild, upland landscapes of the Peak District were more able to effectively absorb Ladybower Dam into the existing landscape order. However, Rutland Water was seen initially as contrary to its setting. Cosgrove *et al.* (1996) position Rutland as part of the domesticated, 'garden' landscapes of England; a small county where human life was seen to be conducted on a corresponding scale, "in harmony with the proportions of the territory itself" (Waites, 1983 in Cosgrove *et al*, 1996: 544). Consequently, the reservoir was seen as disproportionate to its surrounding landscape order to be corrected by sympathetic landscaping. Great care was taken to incorporate the character of Rutland into the design of the reservoir incorporating aspects of human scale and reflecting, representing and enhancing aspects of the human and historic environments in the design of the scheme. Ideas of landscape harmony in the context of scale may well offer new insights into the difference in attitude towards the modest hydro-electric developments of the late nineteenth century, in which the modernity they symbolised was celebrated[4] and their mid-twentieth century counterparts, colossal by comparison and to which many objected on grounds of scale and landscape (dis)harmony (see Payne 1988; Gruffudd 1990; Lorimer 1997).

iv. Regional Economic Regeneration

The inter-war period also witnessed a new phase of regional economic regeneration which was increasingly mediated through large-scale water engineering projects in Britain and the United States (Huxley 1943; Lilienthal 1944; Matthews 1949; Clapp 1955; Kyle 1958; Payne 1988; Gruffudd 1990; Hargrove 1994; Cosgrove et al. 1996; Lorimer 1997; Black 2002). These narratives have been explicitly articulated in writings on the TVA, a scheme that was self-consciously concerned with a broader social and economic manifesto for the State of Tennessee in the 1930s (see Huxley 1943; Lilienthal 1944; Kyle 1958; Hargrove 1994). The TVA was borne out of a new socialist imagining (New Deal), itself a product of the experience of widespread economic depression experienced in the US during the Depression era of the late 1920s and 1930s (Black, 2002). By way of its attention to wide-scale overarching social and economic reconstruction power generation was subordinate to the wider purposes of the TVA (Kyle 1958). As Cosgrove contends, the goal of the TVA mega-project was very much perceived as "social and ideological as much as environmental" (1990: 8).

[4] This assertion will be further investigated in chapters 4 and 5. However initial investigations suggest this to be the case (see Tucker 1976).

Large-scale water-engineering projects realised in British landscape during the inter-war period were also consciously tied to a wider regional regeneration economic agenda. These ideas have also been explored in the context of British landscapes most notably in Scotland, by the cultural and historical geographer Hayden Lorimer (1997) in his exploration of the cultural politics of the Highlands in the inter-war period. Lorimer found that debates about the development of water-power in Scotland during this hiatus of war proceeded informed by the perceived need for regional economic regeneration. Commentators, for example H.F. Campbell, a Fellow of the Royal Scottish Geographical Society, having recognised the potential and economic importance of the region's natural resources, was convinced of the need for hydro-electric power, asserting that "the future of the Highlands depends largely on afforestation and the development of water power" (Campbell 1920: 15). In his particular prescription for *Highland Reconstruction* Campbell predicted the growth and importance of hydro-electric power to the regeneration of the Highlands. Campbell's vision was one of social and economic regeneration rather than support for hydro-electric generation *per se* and his proposals for water-power were contextualised in the objective of preventing further unemployment and subsequent out-migration, a particular affliction of the Highlands. Corresponding with his Socialist approach, Campbell's vision of commercial hydro-electric supply would "benefit the people of the country rather than yield profit to commercial corporations" (Campbell 1920: 17). Correspondingly, the hydro-electric power generation was as much about economic regeneration as it was about bringing modernity to Scotland (Payne 1988).

The connections between large-scale water engineering projects and regional planning objectives are also drawn out by Cosgrove *et al.* (1996) in their reading of twentieth century reservoir construction in Derbyshire and Rutland. Ladybower was explicitly linked by the press to optimism about post-war reconstruction as the scheme was borne out of the early twentieth century desire for modern amenities such as the provision of improved sanitation and associated clean drinking and washing water (Cosgrove *et al*, 1996). Local writer Brian Waites (1972; 1973; in Cosgrove *et al.* 1996) observed that the Rutland Water reservoir scheme brought into focus planning, sociological, biological and educational issues on a grand scale, therefore serving a new social manifesto for the region and the nation.

Post-war hydro-electric development in the uplands of North Wales also carried a regional regeneration remit. In an exploration of landscape and nationhood in mid-twentieth century Wales, Pyrs Gruffudd's (1990) explores post-war hydro-electric debates. Gruffudd (1990) observes how in the immediate post-war period Plaid Cymru (representing Welsh Nationalism) called for industrial dispersal in an effort to stem mounting rural depopulation and reinforce localised economies. In doing so, the Party adopted the spirit of the TVA as a method for social and economic rejuvenation of the region, The TVA model of regional regeneration was advocated by Welsh nationalists as it allowed for widespread control of a region, separatism and the perceived preservation of beauty without compromising utility or sovereignty (Matthews 1949; Gruffudd 1990; Roberts 2006).

The connection of large-scale water engineering projects to regional modernisation was made however much earlier during the closing decades of the nineteenth century. Roberts (2006) has shown that nineteenth century the Vrnwy and Elan Valley reservoir developments for the provision of water to Liverpool and Birmingham were also about modernisation. Drawing on the work of Richard Coopey (2000) who considers the Birmingham development more closely, Roberts shows how such projects in landscape modernisation were associated with the ideas about the 'progress' of humanity (Roberts 2006). Not only did such municipal projects bring clean water to expanding urban districts, thus working to improve sanitation, the re-modelling of landscape through great reservoir schemes vicariously brought modernity to the rural locale in which regional regeneration was realised through the provision of new housing, schools, and road and rail communications (Roberts 2000; Roberts 2006). In this way landscapes were modernised through the provision of modern facilities and aesthetic order.

v. Landscapes of Knowledge

Having considered the main themes of landscape and water-engineering through which ideas of modernisation have been channelled one further aspect of the literature informs the wider thesis and thus warrants consideration. In their attention to pre-twentieth century engagements with water-engineering and landscape both Daniels (2005) and Roberts (2006) have alluded to the role of such schemes in the construction and production of landscape. In his examination of Turner's reworking of his earlier image of Nottingham Daniels quotes Ruskin's comments on the work which associated it "with certain new thoughts and knowledge but never shaking the central pillar of the old image" thereby acknowledging the extent to which the modernisation of landscape, and thus particular elite knowledge were reflected through such practices (Daniels 2005: 31)[5]. However, through his focus on the work of the eighteenth engineer George Revill (2007) pays the greatest attention, albeit subtly, to ideas about the role of the engineer in the constitution of landscape and demonstrates the way in which such projects impose particular scientific knowledges on landscape and thus how certain elites become integral to the production of landscape. Reversing this notion, through the work of the eighteenth century engineer, Revill considers how the work of the engineer, through the way in which it constituted landscape as a new form of moral governance, worked to appoint a new cultural authority as the engineering community emerged as a new professional elite. This is something which Roberts, through his contention that the Vrnwy and Elan reservoirs "should perhaps be seen as symbols of 19th-century British engineers' boldness and self-confidence" demonstrates was asserted a century later (Roberts 2006: 123). Robert's assertion thus supports and illustrates Revill's observations about how landscape and scientific knowledge were mutually constituted in the eighteenth century.

2.2.2 Landscape and National Identity

The relationship between landscape and its role in the constitution of national identity has been a common theme within discourses of cultural geography in recent decades, perhaps most specifically by David Matless (1998) in relation to

[5] Although Daniels does not explore these ideas further in this text, he does so elsewhere in relation to Turner's artistic depictions of landscape (see Daniels 1993).

ideas of the English identity. Ideas of national identity are also a recurrent theme within discourses of water, engineering and identity where notions of Scottish, Welsh and English identity have been explored in relation to large-scale hydro-electricity schemes and reservoir construction which have challenged ideas of national identity which have been constituted through ideas of traditional landscapes to which such structures were considered antithetical (Gruffudd 1990; Cosgrove et al. 1996; Lorimer 1997; Roberts 2006).

i. Modern Structures in Traditional Landscapes

In creating these new landscapes of large-scale water engineering the proponents of modernistic design were challenged by those who sought to maintain 'traditional' landscapes, devoid of such modern structures and technologies. Conflict over what constitutes the 'right' balance between 'beauty' and 'utility' is an enduring theme within discourses of water, engineering and landscape (see for example Gruffudd, 1990; Lorimer, 1997; Cosgrove *et al.* 1996). The heart of this conflict hinged on opposition to the expression of modernity in the landscape, often perceived as incongruent with both 'domesticated' landscapes and in the case of mid-twentieth century Scottish hydro-electric developments, 'wilderness' landscapes. This is documented in Hayden's Lorimer's account of the political and cultural struggles of the Scottish Highlands during the first half of the twentieth century, in which he found that the landed and sporting interests of the Lairdocracy combined with Scottish rural preservationists discourses to obstruct inter-war hydro-electric development in the region, seen by many as the solution to the region's economic inertia (Lorimer 1997).

Extensive physical alterations to rural landscapes through large-scale water-engineering projects have in the context of large-scale water engineering schemes (and elsewhere), through the perceived threat to the countryside, brought about threats to the identity of particular regions and their inhabitants. Within the literature it is argued that national identity is often constituted through ideas about landscape (Cosgrove and Petts, 1990; Gruffudd, 1990; Lorimer, 1997; Matless, 1998). In the context of water-engineering this has been explored by Cosgrove *et al.* (1996) who suggest ideas about national identity are informed by cultural constructions of the countryside. In the context of hydro-electric power projects, both Gruffudd (1990) and Cosgrove and Petts (1990) have argued that the protection of landscape, works as a metaphor for the protection of national identity, perceived as under threat from such modernising structures. 'Traditional' landscapes are seen to embody and protect particular cultural identities as both the bastion and custodian of particular practices. In the context of national Welsh identity Roberts (2006) examines how during inter-war period, opposition mobilised against further water-supply schemes, such as a proposal to dam the Ceiriog river near Wrexham for the supply of drinking water to residents of Warrington, challenged notions of national identity through undermining "the beauty, culture, morality and even the racial strength of Wales" as such projects in modernisation threatened to dilute the "storehouse of culture, values and spirituality" embodied in the *gwerin* people of upland Wales (Roberts 2006: 127). Similarly, the proposed hydro-electric schemes proposed in the post-war period in Snowdonia which involved the creation of seven power stations considered in relation to inter- and post-war Welsh politics by Gruffudd (1990) "represented an intolerable intrusion of modernity into an ancient and timeless landscape" (Roberts 2006: 129).

In reference to English identity, Cosgrove and Petts (1990) argue that the countryside plays a significant role in the construction of the national self, an argument which has been further explored and supported by David Matless in *Landscape and Englishness* (1998). In what the authors posit as a 'quintessential English county', Cosgrove *et al.* (1996) suggest that resultant threats to regional identity in Rutland, through the construction of Rutland Water in the late 1960s, were based on both scale and ideas about the county as a domesticated, bucolic landscape with a corresponding social order. The submergence of this landscape for the creation of the reservoir signified the supplanting of one form of national identity by another, newer form. Settlements, representing a highly developed localism, rurality, and a bucolic social order firmly embedded within the Rutland landscape were lost to a large-scale reservoir for the supply of water to the surrounding urban environments, symbolic of a new, modernised, progressive order (Cosgrove *et al.* 1996).

Both Gruffudd (1990) and Lorimer (1997) have illustrated how Welsh and Scottish national identities respectively are also constituted through ideas about rural landscapes. Pyrs Gruffudd's reading of landscape, nationhood and hydro-electric development in post-war rural Wales (1990) illustrates that landscape, especially that classified as 'unspoilt' and 'rural', plays an integral part in regional/national cultural identity. The perceived intrusion and resultant despoliation from the 'march of progress' seemingly threatening to that identity due to a shift closer to ideas about 'city', synonymous with those of 'progress' and technical modernisation. Hydro-electric developments, as modernistic visions of electricity generation, corresponded with these ideas and as such were a source of conflict in post-war rural Wales. In the way such projects challenged notions of national identity, Geographers have shown how large-scale water engineering projects imposed on 'traditional' landscapes worked to reconfigure such regions as landscapes of conflict as the inhabitants of such regions sought to oppose the implementation of such schemes (Gruffudd 1990; Cosgrove et al. 1996; Lorimer 1997; Roberts 2006)[6].

ii. Landscape and the National Body

David Matless (1998) has shown that constructions of the national identity are often constituted through ideas about the national body. This notion can be drawn out from discourses of water, engineering and landscape in which notions of the national body connect to ideas about public health and vitality (Gruffudd 1990; Lorimer 1997; Roberts 2006). To illustrate these ideas the case of regional hydro-electric developments in the Scottish Highlands can be considered. In exploring inter-war cultural and political conflicts in the region, Lorimer (1997) demonstrates how this model of regional regeneration went against ideas about regional identity in the Highlands. Lorimer (*ibid.*) reveals how early twentieth century Highland discourses constructed the image of the 'Highlander': a timeless, mystical race, completely antithetical to concepts of 'modernity',

[6] Roberts (2006) has also shown that protests against the construction of a water-supply scheme at Thirlmere in the Lake District in the late-nineteenth century by the Manchester Corporation were borne out of protectionist ideas about English rural culture and natural beauty.

represented by large-scale hydro-electric power schemes. Drawing on Thomsen's (1938) ideas of the 'Highlander' expressed in a report opposing hydro-electric development in Scotland, themselves informed by theories of environmental determinism, Lorimer (*ibid.*) conveys how the image of the 'Highlander' was used to argue against the development in the Highlands. For Thomsen, the ***right*** kind of regeneration is largely determined not only by the environment, but also by the race of people by which it is inhabited, defined as follows:

> The Highlander has from time immemorial been shepherd, farmer in a small way, hunter, forester or fisherman, In these open air occupations in a mountainous and a changeable climate, he has grown physically strong and hardy; on his small croft, facing the daily emergencies of farming in a fickle climate, often isolated from all help but his own, he has developed decision, self-reliance, and resourcefulness. His own master at all times he has acquired a sense of personal worth and a steady independence of character. Solitude among the mountains has made him self-possessed, contact with great natural beauty and solemn grandeur has fostered the imagination born in him with his Celtic blood, and inclined him to serious thought tinged with mysticism (Thomsen 1938: 38).

The seemingly holistic lifestyle of the Highlander is at odds with a modern regeneration program and the proposed location of a chain of chemical factories along the Great Glen would, according to Thomsen, serve to irrevocably alter the mental and physical distinctiveness of the Highlander:

> Teach him to eat and sleep to a time table, to muster at the summons of the factory whistle, to work of one of a gang, and his manly independence, his sense of personal

worth, his dignity and courtesy will follow his physical vigour on the road to extinction (Thomsen, 1938: 38).

Thomsen's conceptualisation of the Highland environment and those by which it is inhabited corresponds with Cosgrove and Petts' (1990) reading of upland landscapes which they suggest have historically been associated with "more visceral senses and, metaphorically, with care for the physical health of the national body" (*ibid.*: 538). Cosgrove and Petts (1990) place this observation in the context of their discussion of resistance to hydro-engineering developments, which would interfere with this human experience of landscape as wilderness. Thomsen's argument can be placed as an illustration of Cosgrove and Petts' (1990) observations. Although there was little disagreement that the Highlands were in need of economic regeneration, there was conflict over the exact nature of the regeneration and its appropriateness to the perceived physical and mental characteristics of the native population, perpetuated by the image of the 'Highlander'. Large-scale water-engineering schemes threatened notions of regional identity as they were antithetical to the image of the Highlander which informed ideas about regional cultural identity. This sense of landscape as a harbour of a particular set of ideas about national culture and identity that connected to the national body was also drawn out by Roberts who argued that notions of welsh hillscapes connected to notions of "cultural timelessness and spirituality" (Roberts 2006: 123). However, instead, Roberts articulates how this sense of identity was used to promote such schemes to the resident populations of Liverpool and Birmingham by attaching to the notion of the purity of Welsh water, which was otherwise connected to concerns over taste and quality. Notions of Welsh landscape which by virtue of their isolation and remoteness from urban civilisation were promoted as historic and pure with health bringing qualities were brought to bear on late-nineteenth century reservoir schemes (Coopey and Roberts 2003; Roberts 2006). Notions of purity were constructed to convince the wider body politic of the benefits of the schemes (Roberts 2000). In this way such discourses connect to narratives of 'health' and the national body explored more widely elsewhere (Matless 1998; Matless 2001).

iii. Nationhood and Sovereignty

However, where such developments in England and Scotland connected most strongly to a threat to national identity, in Wales these debates were most strongly mobilised and channelled through discourses of water-engineering and national sovereignty. Both Pyrs Gruffudd (1990) and Owen Roberts (2006) have examined how such projects have connected strongly to ideas of Welsh sovereignty since the late-eighteenth century when Welsh resources were seen to be exploited *by* English interests *for* English interests over those of the indigenous Welsh community. In relation to late-nineteenth century reservoir schemes at Vrnwy and Elan, Roberts (2006) has drawn on the work of Richard Coopey (2000) to explore the idea that large-scale water-engineering developments in the late-nineteenth century Wales were unpinned by "quasi-imperialist ideas" (Roberts 2006: 124). For Coopey (2000) such projects were a way of demarcating each city's territory which through large-scale reservoir schemes extended beyond English borders into Welsh landscape, thus constituting the English appropriation of Welsh landscape, an argument that was again revisited through the development of reservoirs for water supply to Liverpool in 1956 when, amidst fears of the supply from Lake Vrnwy being insufficient, proposals were made to dam the Tryweryn river by the Liverpool Corporation.

Notions of Welsh sovereignty also informed engagements with large-scale water-engineering schemes in the post-war period when concerns over the reserve of Welsh water reserves for the economic benefit of Wales were raised (Roberts 2006; Gruffudd 1990). Both Gruffudd (1990) and Owen (2006) have documented how a regional program of hydro-electric development in the Welsh uplands became the source of considerable cultural and political conflict in the immediate post-war period founded on competing ideas about preservation and Welsh nationhood. Although hydro-electric power development proposed a vehicle for economic regeneration, in the case of post-war economic reconstruction in Wales, issues of sovereignty were also critical to contemporary Welsh politics. Gruffudd has argued that a "consistent theme in Plaid Cymru's territorial politics was the English exploitation of Welsh land, with the manipulation of landscape symbolically read as the redefinition of Wales as part of British space" (Gruffudd 1995: 225). These debates have continued to characterise discourses of Welsh landscape and energy into the late-twentieth and early-twentieth century.

2.2.3 Landscape, Science and Technology

Within twentieth century discourses of landscape, a tradition concerned with the relational place of science and technology has existed. Much of this area of literature has focused on America landscapes. Perhaps most significantly, Leo

Marx's *Machine in the Garden* which examines the role of the socially constructed concept of the American 'pastoral ideal' which, more than a description of a simple, idealised landscape, functioned as a theory of American society in the impact of industrialism and its resultant technological and cultural transformations (Marx 1964).

With the growth of what have been described as 'large-scale technological systems' (Hughes 1989) in the post-war period social theorists such Wiebe Bijker, Thomas Hughes and Trevor Pinch have built on Marx's work adopting a social constructivist approach to ideas of Science and Technology (see Bijker *et al.* 1989), considering both its cultural and historical meanings and espousing the idea of the 'seamless web' of society and technology which argues that technological developments, either as objects or processes cannot be considered in isolation of their social, economic and political contexts (Bijker *et al.* 1989; Hughes 1989). In a similar vein, David Nye has continued to explore the social construction of technology through two substantive works focusing on the role of technology in American culture, society and the social construction of landscape (Nye 1997; 1999). Of particular relevance in his exploration of the introduction of electrical systems to North America in which Nye argues that the development of such systems represents a social as well as a technological transformation (Nye 1997).

Considering the same cultural and technological transformation in Britain, documenting inter-war ideas of technology and landscape, Bill Luckin argued that ambivalence and opposition to technological change which lay at the heart of

British social life worked to obstruct the development of the National Grid between 1927 and 1934 (Luckin 1990). Moreover, like other technological edifices of power generation, electricity pylons were characterised as 'industrial', more sympathetic to the 'urban' environment; an urbanism which was seen to be encroaching on an otherwise ordered rural Arcadia (see Luckin 1990). Much of this antipathy to technology and technological change wrested on its characterisation as 'industrial' which was wholly out of place in landscapes perceived to be pastoral, wilderness or Arcadian (see for example Crowe 1958; Marx 1964; Luckin 1990).

With the growth of technological systems has been a corresponding address of the philosophy of science and technology. Adopting an arguably more radical perspective on the sociology and philosophy of science and technology authors such as the political theorists Langdon Winner (1977; 1979) in America and David Dickson (1974; 1977) in Britain pursued the political philosophy of science and technology. They specifically critiqued the orthodoxy of science and technology in the Western world which came to dominate the social and economic character of twentieth century Western civilisation through capitalist economies, the foundation of which implicitly placed Nature as subordinate to technology as a means to economic growth. These particular debates are explored in more depth in 6.1.

Functioning as a comprehensive literature review this chapter has explored the literatures pertaining broadly to cultural landscapes of power generation, addressing both thematic and more subtly, methodological approaches to the subject matter. These themes are continued in the following chapter which addresses more explicitly the subject of historical landscapes of renewable energy generation and methodological approaches to the thesis.

3 Investigating Landscapes of Power

This chapter performs two primary functions. Firstly, as a means of considering the two principal case studies within a comprehensive contextual historical setting, the chapter provides a survey of the main engagements with renewable energy in Britain during the period under consideration. The second part of the chapter comprises a discussion of how landscapes of power have been investigated here, considering both the methodological techniques employed and the primary sources that have been interrogated.

3.1 Historical Survey of Renewable Energy in Britain

To provide a comprehensive overview, the chapter continues here by providing a historical survey of both realised and unrealised engagements with renewable energy in Britain since the 1870s. In providing this overview, in conjunction with the above summary of literature, the rationale for the principal themes and objects of study of the thesis is supported.

3.1.1 Tidal Power

Despite Mackinder's appeal to engineering professionals to harness Britain's latent tidal power resources for the generation of electric power, over the course of the twentieth century this remained an unrealised environmental vision despite several State proposals to develop such a project. Although other potential sites existed, for example The Wash and the Thames Estuary, discourses of large-scale tidal power concentrated on the Severn Estuary. Bisecting the South West region of England from the Southern coastline of Wales, the Severn Estuary harbours one of the largest tidal ranges in the world measuring up to fifty feet. The first proposal for a barrage across the Severn was published by the Ministry of Transport in 1920. However, the proposal was ultimately denounced as 'visionary' and impracticable, rising costs rendering its construction "right out of the question" (Carter 1960: 138). A barrage across the Severn remained in its conceptual stages until the following decade when further reconfigurations of the scheme were proposed in 1933 and 1945 (Economic Advisory Council 1933; Vaughan-Lee et al. 1945)[1]. This series of proposals however, arguably a strategic response to post-war reconstruction, were frustrated by political and economic forces which effectively halted further development. Typical of the historiography of the Severn Barrage, both proposals were ultimately considered uneconomical and subsequently shelved[2]. By the mid-1930s the region of South Wales bordering the northern shores of the Severn Estuary had been adopted by the State as one of several 'depressed areas' in Britain, proposals for the economic regeneration of which the concept of a tidal barrage across the Severn was central[3].

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[1] The Economic Advisory Council was a Parliamentary body established specifically to address economic decline in Britain (Howson and Wynch 1977).

[2] The Special Areas Commission was established in 1934 by David Lloyd George to deal specifically with several regions of Britain, experiencing economic depression as a result of the industrial dereliction left after the decline of Britain's traditional heavy industries of coal-mining, steel and ship-building.

[3] See Special Areas Commission 1934; 1935; 1936a; 1936b; 1937a;1937b; 1938; Linehan 2000; 2003a; 2003b.

State interest in developing a tidal power generator across the Severn Estuary diminished in the post-war period as issues of post-war reconstruction predominated, although some continued to perceive the project as integral to this process (Caesar 1949). It remained a source of activity within academic arenas over the following decades (Shaw 1965b; Shaw 1965a; Wilson 1965; Shaw 1974) regaining State interest in the 1970s as concerns over resource availability precipitated by the 1973 oil crisis mounted (Select Committee on Science and Technology 1977; Department of Energy 1981). However, perceived threats to the local ecology of the Severn Estuary effectively worked to suppress the project (Shaw 1977; Dineley 1980; Clark 1989). Although ideas of tidal power remained a significant component of late twentieth century (renewable) energy debates and in spite of predictions that "it is sure to be done one of these days", during the twentieth century a tidal barrage across the Severn Estuary remained an engineering vision and a structure by which it could be generated remains to be realised (*Illustrated London News* 30th August 1924)[4].

Despite this, the twentieth century witnessed the realisation of a variety of renewable energy schemes for public supply throughout Britain constructed predominantly in the nation's upland landscapes of Scotland and Wales. These engagements with renewable energy were primarily through water-power in the form of hydro-electric generation through which renewable energy production was developed with increasing scale and operating capacity over the course of the twentieth century.

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[4] Contemporary engineering visions of a structure to harness tidal power from the Severn Estuary have since evolved from a barrage to 'tidal lagoons' (Friends of the Earth 2004).

3.1.2 Hydro-Electricity

Water has historically played an important role in the production of energy in Britain. However, it was not until the 1880s that the potential of water power as a source for the production of electrical energy was recognised. By this time there was already a well-established tradition of water-power in Britain, principally through the use of the watermill but also as a result of the introduction of the turbine in the mid-nineteenth century which enabled water-power to be employed indirectly as steam power, which along with gas drove the majority of ad-hoc electricity generators during the nineteenth century. It was around this time that initial forays into hydro-electric power began and water-power became a form of energy that could be converted into an intermediary, transmitted and employed elsewhere.

Initial imaginings of hydro-electric power may conjure visions of grandiose unapologetic structures; feats of water engineering imposing upon rural, often remote landscapes. Large-scale hydro-electric power developments of this type certainly became a characteristic of twentieth century British landscapes specifically the Scottish Highlands and to a lesser extent the Welsh uplands. However, the beginnings of hydro-electric power for public supply in Britain were characterised by *small*-scale private and municipal projects developed from the early 1870s, developments which, as outlined in chapter 1, constitute the empirical focus of Part II of the thesis. Prior to these developments however, the earliest hydro-electric power schemes in England were adopted for the lighting of industrial, private (for large houses and mansions) and commercial premises

(Tucker 1976). This reflects a similar pattern in Scotland, which towards the end of the nineteenth century was characterised by small plants, serving both individual property holders and small and often quite scattered communities (Payne 1988).

During this phase of development hydro-electric power installations were by twentieth century standards, small-scale both in physical stature and operating capacity. Large-scale hydro-electric power development however began with installations for *industrial* purposes first initiated in Scotland where the resources for this type of development were most abundant. The first scheme for industrial supply was constructed for the Foyers Aluminium plant on the east side of Loch Ness in 1896 (Carter 1960; Cantor 1963; Smith 1971; Johnson 1986; Payne 1988). The success of this operation stimulated the development of several other small-scale private schemes for industrial supply in Scotland before the First World War (Payne 1988). The uplands of North Wales had also been recognised during the early years of the twentieth century for their suitability to large-scale hydro-electric power generation and between 1900 and 1910 three dams were constructed at Ffestiniog, Cwm Dyli and Dolgarrog (Smith 1971; Thomas 1989; Gruffudd 1990; Woodward 1998; Roberts 2006). Operated by the North Wales Power and Traction Company, the schemes supported predominantly industrial interests supplying a number of slate quarries in the region.

Hydro-electric power generation in Scotland continued largely for industrial supply into the second and third decades of the century. However, at the cessation of the First World War hostilities problems of reconstruction in the Scottish

Highlands demanded attention (Campbell 1920; Clegg and Chester 1953; Lea 1969). Geographically, socially and economically peripheral, the Highlands were perceived as an anachronism of the preceding century and in desperate need of economic and social modernisation (Lorimer 1997). Given its suitability to the climate and topography of the Highlands and potential to inject renewed economic vitality, hydro-electric power came to represent a model for economic and social regional regeneration, to which it was recognised as integral (Scottish Office 1942). Thwarted by both political and cultural interests, informed by what can be described as rural preservationist and 'landed' preoccupations it was not until 1943 that a more comprehensive approach to electricity provision in Scotland became possible (Lorimer 1997).

In order to fully embrace the economic regeneration and subsequent modernisation of the region a comprehensive hydro-electric development scheme was required. The 1942 report of the Cooper Committee (Scottish Office 1942) commissioned to investigate the potential of Highland hydro-electric development advocated the formation of a public service corporation and after the 1943 Hydro-Electric Development (Scotland) Bill was introduced, the North of Scotland Hydro-Electric Board (NSHEB) was created with jurisdiction over electricity production and supply in the Highlands (Payne 1988; Lorimer 1997). Between 1951 and 1960, thirty-two hydro-electric schemes were constructed in the Scottish Highlands by the NSHEB incorporating fifty-two individual power stations thus illustrating the vast scale and significance of hydro-electric power and thus renewable energy to Scottish electricity supply (Payne 1988).

Large-scale hydro-electric developments were also witnessed in the Welsh uplands during the post-war period. Between 1944 and 1949 post-war reconstruction and the new socialist British government's plans to modernise the nation through State control of key utilities led to the proposal of six additional schemes (and two extensions) by the British Electricity Authority (BEA) comprising an extensive network of operating stations, dams and tunnels (House of Lords Select Committee 1955; Woodward 1998; Roberts 2006)[5]. However, the success of the proposals was obstructed by cultural conflicts largely co-ordinated by the Council for the Protection of Rural Wales concerned with 'preserving' the Welsh countryside (Gruffudd 1990; Roberts 2006). Similar rural interest groups joined forces to protest against these schemes producing two lengthy publications outlining their objections (North Wales Hydro-Electric Protection Committee 1950; North Wales Hydro-Electric Protection Committee 1952).

3.1.3 Windmills and Watermills

As well as the increasing importance of some forms of renewable energy to national electricity production, by contrast traditional forms of energy generation which for centuries depended on naturally renewing forms of motive power experienced a decline. Windmills and watermills had featured in upland and lowland landscapes for over a millennium, the earliest recorded structures dating back to the eighth (watermills) and twelfth (windmills) centuries. Both were ubiquitous features of the rural landscape by the seventeenth century[6]. Although windmills and watermills shared a common function to provide power for a range

[5] The electricity generation industry was nationalised in 1948.
[6] 7500 watermills were recorded by the Domesday survey (1086-7)

of agricultural and industrial activities, including in the case of windmills, land drainage, the technological and architectural design of the two structures differed, determined by the power source each was uniquely designed to exploit and by association, the landscapes within which they featured. This was reflected in the geographical distribution of windmills and watermills, influenced (but not restricted) largely by topography and climate: windmills featured more prominently in flatter, lowland landscapes, primarily East Anglia and the South-East of England; watermills were a more familiar feature of the British uplands found commonly in North-West England, Scotland and Wales (Skilton 1947).

However, corresponding to increasing rural out-migration since the onset of industrialisation in the mid-eighteenth century, the early part of the nineteenth century witnessed the beginning of the industrial decline of the mill, later illustrated by the 1887 issue of a report on the depression in the milling industry by the National Association of British and Irish Millers (Skilton 1947; Gifford 1999). Over the course of the nineteenth century mills were gradually supplanted by increasingly technological production systems, giving way to different types of power that could produce a greater capacity of energy for the purposes for which mills had traditionally been used and which consequently offered greater opportunities to the manufacturing industry. This wider decline in rural traditional production methods thus signalled the increasing destruction and dereliction of the country's windmills and watermills.

Despite this decline by the 1880s windmills and watermills remained the principal expressions of wind and water-power and from 1877, the local mill began to benefit from a growing cultural trend to preserve built structures, an activity formalised in the establishment of the Society for the Preservation of Ancient Buildings (SPAB) set up in this year. Despite the activities of the SPAB, the numbers of mills continued to decline into the twentieth century as they became increasingly redundant within the local rural economies in which they were situated. As a reaction to continued neglect and an increasing threat of destruction, the Windmill Section of the SPAB was created in 1931 to protect mills from demolition and unsympathetic repair. This was later converted to the Wind and Watermill Section in 1946 to also bring a more focused attention to the latter structures. In 1947, Skilton recorded 2000 derelict mills in Britain but less than one hundred in working order.

From the 1960s however, the rate of decline began to slow. A growing interest in vernacular architecture - expressed in part through the practice of industrial archaeology - as part of a wider architectural and environmental conservation movement supported the increasing preservation of mills around the country. These practices started to become defined through the establishment of local and regional mills groups[7]. The activities of such groups led to the development of national, regional and local networks of mill preservation groups, co-ordinated by the SPAB, which is widely recognised as instrumental in saving many mills from neglect and destruction (Wailes 1979). These activities, as part of a wider architectural conservation movement, effectively halted the seemingly irredeemable decline of the mill. Over the course of the twentieth century, the traditional mill made the transition from vernacular building to site of national

[7] For example the Midland Wind and Watermills Group, established in 1976.

heritage: By the late 1970s, Wailes (1979) recorded over two hundred mills open to the public. Despite the recorded survival of further mills (albeit in a state of disuse and dereliction) by this time an enormous number had already been demolished completely (*ibid.*).

3.1.4 Wind Turbines and Windfarms

The significance of wind-power returned to discourses of renewable energy in the late-twentieth century when from the early 1990s large-scale wind energy in the form of 'windfarms' became the primary practical expression and focus of late twentieth century renewable energy debates[8]. Prior to the early 1980s however it remained very much in its experimental stages. Already pioneers in large-scale renewable energy generation, in the 1950s the North of Scotland Hydro Electric Board explored new wind-energy technologies considering small plants for local use on remote Scottish islands (Payne 1988). This activity was furthered by the Electrical Research Association which also explored wind power technologies and established a body to investigate large-scale wind-power in Scotland around this time (*ibid.*). However, installations remained experimental and the technology was ultimately considered inadequate to cope with a powerful but often unpredictable power source (Haldane 1956).

By the 1960s however, natural sources of energy generation, which emphasised wind-power become the focus of a social movement which embraced the

[8] It is important to differentiate here between the type of power produced by wind*mills* and that generated by wind *turbines*. Windmills harness and employ the energy of the wind directly at the point of source, usually as a method of grinding grain and other agricultural produce. Wind *turbines* however, capture wind energy which is then converted into electrical energy and delivered through transmission lines to the point of use via a generating station.

principles of a growing counter-culture. Concerned over the various adverse affects on the natural environment of the aggressive industrialism of the post-war period which the movement saw as deleterious not only to the natural but also the social environment, this counter-culture explored 'alternative' versions of energy technologies based on the principles of small-scale and appropriate technologies. These engagements are explored in detail in Part III of the thesis.

As the impetus for alternative energy technologies grew (informed by environmental and economic concerns over resource availability) in 1977 the British (Labour) Government published its first report into the prospects of generating electricity from wind power (Department of Energy 1977). Despite these investigations, large-scale wind energy was not adopted as a viable option for mainstream electricity generation until the 1990s when it became a significant component of the UK's renewable energy program and a contested phase of windfarm construction began. The geographical focus for these developments was again concentrated in the Welsh and Scottish uplands with several developments in the south-west region of Britain.

3.2 Methods and Sources

Researching the histories of renewable energy in Britain has involved the consultation of a rich variety of primary and secondary sources. The thesis is fundamentally concerned with two principal subjects of inquiry; research agendas are unified by their historical nature and as such the thesis has employed historical research methods to interrogate the relevant sources, specifically archival research and oral histories. By virtue of the different time periods and subject matter with which each of the empirical parts of the thesis are concerned, I was confronted with two quite different types of historical archive (see below) which in turn necessitated different considerations and methodological approaches informed by and sensitive to each particular area of research. This section of the chapter is thus structured according to the two principal subjects and basis for the empirical sections of the thesis; 'nineteenth century hydro-electric power' and 'the Centre for Alternative Technology'.

Before attending to these two areas of research however, a note on using and investigating historical source material with which both streams of research have relied. As the Industrial Historian Professor D.G. Tucker enunciated in a 1979 editorial "the study of history is inextricably bound up with the search for and preservation of source materials" (Tucker 1979). As a product of historical enquiry the cultural and historical geographies of renewable energy in Britain is thus dependent on existing documentation and the information contained within these documents. The *destruction* of archival material is therefore equally as significant as its survival to the eventual historical narrative that emerges: historical geographers have stressed the idea that the past can only be approached through selective accounts and thus the eventual narrative can only ever be a representation of the past informed by what remains (Wishart 1997). This is especially pertinent to the study of nineteenth century history hydro-electric development. Unlike the Centre for Alternative Technology the factual historiography of which, given its inception during a period that remains within living memory, was supported by oral testimony which enabled triangulation, the investigation of nineteenth century hydro-electric power was entirely dependent on primary and secondary written records. What is told here thus reflects the content of those surviving historical documents.

3.2.1 Nineteenth Century Hydro-Electric Power

The investigation of nineteenth century hydro-electric development has an interesting history within the evolution of the thesis itself. A single footnote in Peter Payne's institutional history of the North of Scotland Hydro-Electric Board detailing Scotland's first hydro-electric scheme at Greenock and its use of a novel experimental cable alerted me to this previously undiscovered area of research (Payne 1988). More general histories of hydro-electric development (for example Carter 1960; Cantor 1963) had hitherto failed to delineate this neglected area of inquiry which now constitutes a major material component of the thesis. The text in question was an industrial archaeology publication by Professor D. G. Tucker pertaining to the first hydro-electric power schemes in Britain for public supply. Through this paper Tucker (1976) collated and explored the particulars of the first eight hydro-electric supply schemes in Britain for public supply. Within this text Tucker outlined his sources which included council and committee minutes books and reports in addition to other miscellaneous archived documents, private correspondence and interviews and (several hundred) trade press reports (see below). The thesis has both been informed by and built on these sources; my debt to Tucker must therefore be acknowledged and prefaces the discussion of how this part of the thesis was researched.

i. Historical Archives

In attempting to construct the history of nineteenth century hydro-electricity for public supply (beyond Tucker) a variety of historical archives were consulted. Given the often municipal and in all cases *civic* nature of these schemes a considerable volume of original material relating to the installations was deposited in local record offices pertaining to the localities in which they were developed. The fifteen schemes of interest were at Godalming, Greenock, Blockley, Wickwar, Okehampton, Keswick, Lynmouth, Chagford, Worcester, Milngavie, Fort William, Salisbury, Monmouth, Fladbury and Ingleton. The histories of these installations were charted through primary and secondary sources, except in the case of Fladbury and Ingleton where neither could be traced aside from historical gazetteer entries. However, it is important to note that despite the novelty of late-nineteenth century hydro-electric development the perceived historical significance of such schemes is reflected in a void of surviving historical documentation. Despite extensive researches, primary records could not be traced for some of the fifteen schemes considered. Others however, particularly those operated by local authorities were detailed in Council minutes and other municipal and civic records deposited in local record offices. Other repositories included private organisations' collections. The material consulted is considered below by particular archived collection.

By far the most significant and largest collection was concerned with the Worcester Hydro-electric station, now held in the Worcester City Council collection at the Worcester Record Office. Of most significance were the comprehensive minutes of the respective Council Committees responsible for the development of the Worcester's electricity supply in the late-nineteenth century. These were those of the Watch and Lighting Committee from 1872 to 1894 (when the size and importance of the scheme demanded the creation of a separate committee devoted to electricity) and the Electricity Committee from 1894 to the early 1920s. The archive also held additional historical material deposited by the Local Authority which comprised technical plans, commercial tenders, correspondence, advertising material, financial records and other miscellaneous documentation. Other non-specific primary and secondary sources were also consulted at this archive in relation to the development of the Worcester hydro-electric station which included local history publications, maps and other miscellaneous material indexed by subject, place or person name.

Other important local authority collections included the minutes of Godalming Town Council held at The Surrey History Centre (Surrey's local record office) which also contained illustrations, newspaper articles and correspondence relating to the Godalming hydro-electric station. Original sources were also located at the North Devon Record Office (in Barnstaple) and the South Devon Record Office (in Exeter) where newspaper cuttings, books, promotional material and company records were located. In reference to Greenock, Minutes of the Police Board and Harbour Trust were consulted.

Other than records held in local record offices, the archive of the South Western Electricity Historical Society (SWEHS) was also consulted[9]. SWEHS is a

[9] See www.swehs.co.uk

historical organisation located in Bristol established by a group of electricity and industrial archaeology enthusiasts devoted to the preservation of the history of electricity generation in the South-West region of England. Archived original sources included photographs, maps and newspaper articles in addition to an extensive collection of trade journals (see below) and secondary publications relating to the history of electricity generation which vicariously includes hydro-electric production.

ii. Contemporary Trade Journals

Not only was the discovery of Tucker (1976) beneficial in outlining the primary hydro-electric stations for public supply during this period, the article was also useful in delineating some of the key primary sources pertaining to this field of enquiry. Specifically, Tucker referred to several contemporary trade journals through which nineteenth century hydro-electric development was investigated. Namely, these were *The Electrician* and *The Electrical Engineer*, but in the course of my enquiries I also discovered the *Electrical Review*. The eminence of Engineering as a profession by the late-nineteenth century (as alluded to in chapter 2) meant that it boasted this series of trade journals as well as professional bodies and institutions, in particular the Institution of Electrical Engineers, the proceedings of which were reproduced in the Journal of the Institution of Electrical Engineers.

The journals consulted were each published on a weekly basis. As well as providing advertising space for the latest products and services developed within the field of electrical engineering from electric light fittings to complete systems installation, the journals recorded developments in the electrical engineering trade. These related predominantly to the emerging field of electric lighting development and provision, including where systems were powered by water power, a factor which was often highlighted on the grounds of its novelty (see Part II).

As well as a record of the most recent developments in electrical engineering technology these journals served as a literary forum for the discussion and debate of topical industrial matters by electrical engineers working in the field. Such articles most commonly pertained to the comparative advantages of gas and electricity provision, including relative costs and those of alternative sources of electrical power, i.e. coal powered steam over water-power (see chapter 4). The journals also served as weekly gazetteers of electricity-supply installations during this period in which on-going developments in recently commissioned hydro-electric stations were documented. These sections were particularly useful in delineating the number and location of hydro-electric installations during the period under consideration and thereby confirming Tucker's (1976) findings.

The trade journals consulted were collected sporadically with only a handful of libraries nationwide holding a comprehensive collection. One of these repositories was The Bodleian library at the University of Oxford. These volumes of *The Electrician*, *The Electrical Engineer* and the *Electrical Review* were consulted both in the main library building and (by special arrangement) in the Library's archived store on the outskirts of Oxford where particularly delicate volumes are housed for preservation. The South Western Electricity Historical Society also held a substantial collection of *The Electrician* and *The Electrical Review* which were available for consultation during my visit where volumes were missing or otherwise absent from the University of Oxford's collection.

3.2.2 The Centre for Alternative Technology

i. Historical Archives

The investigation of the CAT project involved the consultation of several historical collections of material. Unlike the archival material researched in relation to the investigation of nineteenth century hydro-electric generation, the bulk of the material relating to CAT and engagements with alternative energy technologies in the 1970s constituted a more informal 'archive'. Of greatest significance was the 'institutional archive' of the project itself housed at the Centre in North Wales. However, what existed prior to my contact and subsequent involvement with the Centre constituted several cardboard boxes of randomised, uncategorised historical documents. Such was the undetermined value and organisation of this material that on my initial contact with the Centre for Alternative Technology I was told that its discovery only several weeks earlier had prompted discussions of the value of the material and what steps should subsequently to be taken, one of which alarmingly was to dispose of this vastly rich cultural and environmental archive, a course of action which would greatly have compromised the integrity and credibility of this research project which has been qualitatively informed by material discovered within those several cardboard boxes. It can be said that the informal nature of these archives reflects the general spirit of the project and the counter-culture through which it was fostered which rejected such normative approaches to regulating and formalising practices. Given the unordered and subsequently uncatalogued nature of this material, where it is cited directly it is referenced throughout the thesis by a description of the item or where applicable the name of the document where titled (followed by 'CAT archive, CAT' to denote the archive source and location).

Contained within those several cardboard boxes was a rich archive of written and visual sources pertaining to the embryonic years of the projects development, predominantly the first three years between 1973 and 1976. Within these documents a sense is given of the way the project functioned, those involved and the particular ideological and philosophical approaches to alternative technologies and societies which underpinned the project. These aspects are detailed in project manifestos, mission statements, correspondence, project diaries, accounts, maps, plans, sketches and diagrams, promotional material and visitor centre information. A separate cardboard box contained newsletters published by the centre from 1976 to 1981 which detail the physical, social and ideological evolution of the project between these dates. Also held within this archive were some of the project's more formal published histories undertaken after ten and twenty-five years of operation, which also served to inform the research process (Brown 1985; Centre for Alternative Technology 2000). Having established the nature and content of the archive during a visit to the Centre in autumn 2005 this archive was consulted on three separate occasions, each time at the Centre's administrative offices, a process which was orchestrated by the Centre's administrator and informal 'guardian' of the archive Rick Dance. Rick also provided me with a detailed tour of the site. In this respect the landscape of CAT constituted a historical and cultural artefact in itself (although CAT continues to evolve and function within this historical artefact).

The research process also relied on the consultation of a second informal personal archive belonging to Peter Harper. This constituted a collection of published and unpublished written sources, specifically a collection of *Undercurrents*, a contemporary journal devoted to the pursuit of alternative technologies that Harper edited from its beginnings in 1973 to the late-1970s and several secondary sources which comprised his personal copies of texts that he had written on the subject (Harper 1974; Boyle and Harper 1976; Harper 1976; Harper 1995).

In addition to these informal collections of historical material, given the industrial nature of the project for which planning permission was necessary, an extensive supply of planning documentation was available for consultation at the local planning office of Powys County Council in Welshpool. Local authority reorganisation in 1973 presented some initial problems in locating these records as jurisdiction for the site on which the project was developed had shifted from (the now obsolete) Montgomery County Council to Powys County Council. A total of 46 planning submissions made in relation to the CAT project and the Llwyngwern Quarry site before it were consulted which included individual applications (often inclusive of sketches, plans and maps), council minutes where these applications were discussed and records of the planning decisions in addition to supplemental material relating to individual applications.

One further primary resource which proved invaluable in the search for the historiography of CAT was the founder's autobiography (Morgan-Grenville 2001). Within this text Morgan-Grenville recounts not only his engagements with the Centre but also his childhood experiences and those in adulthood leading up to the initiation of the project. This additional information therefore provided a biographical interpretation of his influences and motivations in establishing a Centre for Alternative Technology. This primary textual source was approached in two ways. Firstly it communicated certain factual information regarding the institution of the project, from which I was able to obtain particular names, places and dates from which I could further my enquiries. Secondly, through the way the text was approached and its content, the book communicated particular aspects of the founder himself through which I was able to further interpret his own particular engagements with alternative energy technologies in welsh uplands in the 1970s.

Newspapers and several secondary sources were also consulted at the National Library of Wales which held a comprehensive list of press publications pertaining to the North and West Wales region during the period of interest.

ii. Oral Histories

Oral history theorists are agreed that this method offers a way of accessing more recent histories which for various reasons may be otherwise disadvantaged (Portelli 1981; Thompson 1988; McDowell 2002). As the histories of CAT remain within living memory, archival research was supported by the oral histories of some of its most significant personalities and colleagues who were both witness to and contingent within its institution, as a means to supplement and enhance the interpretation of written records. McDowell (2002) and Portelli (1981) argue that oral histories provide information about the lives of both ordinary people and certain marginalised social groups whose histories are either absent or distorted from the written record, categories to which the counter-cultural social groups associated with CAT might arguably conform. Given the fragmentary nature of the historical archives pertaining to CAT, oral testimonies were sought as a means of both triangulating what had already been discovered and reconstructing the past where it was otherwise absent from the existing written and visual archive. This method also provided a means of unlocking *personal* narratives and experiences that might remain otherwise untold (McDowell 2002). Through this approach the positionalities of particular interviewees could be understood in relation to the historiographies detailed elsewhere within the historical archive. The interviews were approached as a means of both exploring further the unique ideologies that fostered engagements with alternative energy technologies in the early 1970s but also as a source of factual historical reference. Furthermore this semi-structured approach allowed for the discussion of other aspects and events not detailed elsewhere. Effort was made to attend to the particular requirements of the interview without compromising individuals' particular expressions, own accounts or points of interest (Jones 1985; Valentine 1997).

What must be kept in mind with this particular research method is that it deals in memories rather than facts (Portelli 1981). However, from this perspective it is a

useful historical research method as the significant can be differentiated from the insignificant (from the interviewees' perspective) as what is remembered demonstrates in itself the significance and similarly the symbolism of particular historical facts or events over others that may have been otherwise forgotten.
My contact at CAT, Rick Dance, who had already facilitated my access to the CAT 'archive', was also instrumental in introducing me to several key individuals integral to the history of CAT to whom he remained connected through an informal CAT network. Given the focus of the research on the embryonic stages of the CAT project my interest was in interviewing the key actors in its original genesis and early stages during which it came to be established. The key actors I interviewed are listed in figure 3.1. By prior arrangement, in most cases initially by formal letter and subsequent telephone or email correspondence, each individual was interviewed in their own home as was the most convenient arrangement to each interviewee. This was with the exception of Audrey Beaumont (see below).

The choice of interviewees was to some extent dictated by the content of the archival material already consulted so that particular aspects could be pursued where gaps in the chronology or otherwise were found and others could be explored further and clarification on particular areas achieved. The emphasis for each of the interviews was therefore sensitive to and informed by the particularities of each individual's involvement with the project. Each interview was recorded using a small recording device and the interview subsequently transcribed and the content analysed using a predominantly thematic approach[10].

Two rounds of interviews were conducted; the first in November 2005 to coincide with the completion of archival research at CAT and the second in April 2007 when the founder and the first Project Director, both of whom I considered to be the most influential actors to the project's formulation, after thorough consultation of the 'archive' and other sources, were interviewed. By arranging these two interviews after consultation of the entirety of the primary sources available, including other key actors, more informed, thorough and comprehensive interviews were able to be conducted. Furthermore, from a logistical point of view it made sense to interview these two actors at the same time, as unlike the other interviewees, they resided within close proximity to one another within environs of south-west England. The other interviewees given their ongoing affiliation to CAT remained resident in and around Machynlleth. The first round of interviews thus included Peter Harper, Audrey Beaumont and Bob (and Liz) Todd. They were conducted in no particular order.

The first interview conducted was with Peter Harper, Alternative Technology theorist, author and CAT employee from 1983. Given his direct involvement, Harper was primarily interviewed with regard to the Alternative Technology movement in the 1970s, having written several texts on both the theoretical and practical engagements with Alternative Technologies in the 1970s. Although he was not directly employed by the Centre until 1983 he was affiliated to the project

[10] Written notes were also taken during each interview as both a back-up in the event of failed technology and also as a means of recording my own personal notes and observations made during the interview.

through informal social and cultural networks from its beginnings so was able to offer certain insights into the project (Harper 1974; Boyle and Harper 1976; Harper 1976; Harper 1995). His oral testimony regarding both the movement and the CAT project was thus considered extremely valuable to the research.

The second interview was conducted with Audrey Beaumont, the widow of the late John Beaumont, landowner of Llwyngwern Quarry in which CAT is located. Given her position as landowner, local resident and CAT affiliate her oral testimony was considered valuable. Audrey Beaumont chose to be interviewed in the small gift shop that she runs on the main high street in Machynlleth. Despite its prominent location in the centre of the town, on that particular morning the level of custom did not compromise the integrity of the interview. Now in her seventies, great care and sensitivity was taken when interviewing Audrey Beaumont who despite being widowed for some years understandably showed some reluctance to discuss in any great length or detail certain matters pertaining to her late husband's affairs.

The third interview was with CAT's first Technical Director Bob Todd who was instrumental in establishing the technical foundations of the project in its embryonic stages. His wife Liz had accompanied Bob to Machynlleth and worked as a volunteer living with him on-site for several months. Her remembrances were thus equally as valuable as her husband's and both were interviewed together; it is the author's opinion that their partnership of over thirty years bore no impediment to the results of the interview and their discussions throughout the interview often worked to clarify particular details which might otherwise have remained uncertain. Bob Todd also supplied copies of miscellaneous original material through the post during the ensuing weeks after the interview.

The second round of interviews took place in April 2007. The first of these was with the Project's first Project Director Roderick James. Given James' direct and strategic involvement with the project immediately after the period on which the historical archive is focused he was able to provide particular factual information that was otherwise absent.

Name	**Role**	**Date**	**Duration (apx.)**
Peter Harper	Biologist, 1975-present	November 2005	1 hour 30 minutes
Audrey Beaumont	Widow of the late John Beaumont who was Landlord of Llwyngwern Quarry	November 2005	45 minutes
Bob and Liz Todd	Technical Director, 1974-1998 and CAT volunteer 1974-1976 respectively	November 2005	1 hour 45 minutes
Roderick James	Project Director 1975-1980	April 2007	1 hour 45 minutes
Gerard Morgan-Grenville	Founder and Patron 1973-present	April 2007	2 hours

Figure 3.1 Table of CAT interviewees

Lastly, but perhaps most significantly, the founder of CAT Gerard Morgan-Grenville was interviewed. In addition to information held in the CAT archive, and the testimony of others, the interview built on and was informed by his recent autobiography (Morgan-Grenville 2001). Further notes on these two particular interviews are detailed in Part III.

II

Hydro-Electricity and the Victorian Environmental Vision

> It may not be unadvisable to consider briefly some of the industrial purposes the enormous water-power which Nature has placed so abundantly at our disposal ... one of the many purposes for which this water-power might be made available would be the driving of water-motors for the production of the electric light (Grierson 1881: 105).

At the beginning of the twenty-first century, in an energy economy driven by ideas of 'renewability' and 'sustainability' Grierson's proposal may seem like an obvious suggestion. However, in 1881, towards the end of the nineteenth century the production of electricity from the natural motive force of water was an extremely novel practice. This was true despite an enduring history of water-power as the mainstay of agricultural and industrial production since the twelfth century. What occurred over the course of the nineteenth century was the result of primarily a technological but also a socio-political revolution which both fostered and facilitated the conversion of water power to electricity.

Correspondingly, the following two chapters trace the development of the first hydro-electricity supply stations in Britain which contrary to some published accounts were realised much earlier than imagined[1]. Not only were these schemes amongst the first electricity generation stations for public supply they were also powered by a naturally renewing source. Therefore, in tracing this history, Part II also provides the historiography of the first *renewable* energy schemes for public electricity supply in Britain.

In researching the history of renewable energy as a source of public electricity generation it has become evident that its origins remain largely unexplored. That is, as discussed in chapter 3, aside from a publication by D.G. Tucker, a historian in the field of Engineering, who undertook a survey of the first hydro-electric schemes for public supply in Britain in the 1970s the content of which provides the foundation of the second part of this chapter and that of chapter 5 (see Tucker 1976). However, with the exception of Tucker (1976), the origins of hydro-electricity for public supply, have been otherwise neglected, a point on which Tucker theorised. Such schemes were both small-scale[2] and "remote from the towns" which is why Tucker believes the schemes in question never developed as significant sources of electricity generation (*ibid.*: 126). Subsequently, it can be argued that this is why the early history of hydro-electricity, and thus renewable energy, has thus far been overlooked. Later, and significantly, *larger* hydro-electric developments constructed for industrial purposes from the late nineteenth and early twentieth centuries along with those constructed by the North of Scotland Hydro-Electric Board from the inter-war period have attracted greater attention thereby demonstrating their perceived comparative importance (see

[1] Some authors have cited the large-scale industrial schemes that developed in the 1890s and early twentieth century in Scotland and Wales as the first examples of hydro-electricity generation. See for example Carter (1960); Smith (1971).
[2] Compared to later twentieth century developments they were physically smaller, with much lower operating capacities.

Carter 1960; Smith 1971; Payne 1988). Part II thus attempts to address this void in tracing the intimate histories of thirteen of the first hydro-electric stations opened in Britain before the turn of the twentieth century. Twelve of these stations are considered in the second part of chapter 4 whilst the thirteenth is considered as a substantive case study in chapter 5.

4 Hydro-Electricity in the Nineteenth Century

In the late-Victorian era, one characterised by technological development, industrialism and ideas of 'human progress' (Hannah 1979; Roberts 2006), the motive power of water was harnessed, albeit on a modest scale, for the first time to create hydro-electricity. Although over the course of the twentieth century electricity became a substitute for mechanical process, its first use was in electric lighting for the country's villages and towns. As intimated earlier although hydro-electricity was a novel method of employing water-power, the employment of water as a source of energy was by no means new. What was different about this type of use however, was the ability to convert the motive force of a natural resource into a transmittable form which could be employed at places other than the point of source.

The evolution of water-power in this sense was the result of the culmination of several factors. Predominantly driven by Victorian technological innovation, the introduction of a naturally renewing source to power electrical generation was also the result of *industrial, socio-political* and *cultural* factors. As a prelude to the section 4.2 and Chapter 5, these aspects are considered here.

4.1 The Advent of Hydro-Electricity

4.1.1 Technological Origins: Victorian Innovations in Electrical Engineering

As stated above the first application of electricity was the lighting of public and private spaces. As such it is necessary to provide some background to the advent of this technology and aspects of water-engineering which ultimately drove the commercial production of electricity for public supply and the first development of hydro-electricity.

Despite its much later introduction in the penultimate decade of the nineteenth century the development of the technology required for the public supply of electric light began almost a century prior. Electric lighting employed the use of two different types of technology; arc lighting and incandescent lamps[3]. Although it was the latter which eventually came to dominate the public lighting industry, it was the former that was first discovered by the chemist and inventor Humphrey Davy who demonstrated the technology in 1808 (Byatt 1979). Despite the significance of this invention as the first form of electric lighting ever demonstrated, it was the discovery of the dynamo and the theory of electromagnetic induction (the principle behind the dynamo) by Davy's assistant, the scientist Michael Faraday in 1831 that lay at the heart of nineteenth century electric lighting innovation (Byatt 1979; Hannah 1979)[4]. Experiments with small dynamos were subsequently conducted over the following forty years and by

[3] For a detailed description of both arc lighting and incandescent lamp technology see Schivelbusch (1988).
[4] A machine for converting energy in the form of mechanical power into electric currents.

1857 small generators were being used to produce arc lighting in lighthouses (Hannah 1979). Despite these early forays into electric lighting technology it wasn't until the 1860s and 1870s with the development of machines mainly by the notable Belgian electrician Zénobe Gramme and the German engineering brothers Siemens that there was any sign of a machine that could be used commercially to support public lighting (Byatt 1979; Hannah 1979)[5].

Despite its advantages over other systems, arc lighting with its intense beam and "offensive smell"[6] ultimately proved unsuitable for domestic use. Throughout the nineteenth century Davy and others had experimented with incandescent lighting (Byatt 1979), but it was Joseph Swan, a prosperous chemist and inventor from Newcastle who provided an alternative. On 18th December 1878 Swan demonstrated to the Newcastle-on-Tyne Chemical Society that a carbon filament in an evacuated glass globe would glow when an electric current was passed through it thereby exhibiting the first incandescent lamp (The Electricity Council 1973a; Hannah 1979). Swan joined the British arc lighting pioneer R.E.B. Crompton in the manufacture of his invention and shortly after, together with his American competitor, established the Edison and Swan United Electric Light Company to manufacture lamps and install electric lighting systems[7].

[5] The full name *dynamo-electric machine* was allocated by Siemens in 1867 to distinguish his invention from the *magneto-electric machines* previously used in which the electric current was generated by means of a permanent magnet (www.oed.com accessed 7/11/06).

[6] Quote taken from the report of a committee appointed to investigate the threat of electricity to the main London gas company, quoted in WJ Cotton, 'Kensington's Electricity Supply: its Nineteenth Century Beginnings', unpublished diploma in History thesis, University of London, Department of Extramural Studies, 1972, 3 (in Hannah 1979: 6).

[7] Edison had developed the same technology concurrently in the US. In 1882 Swan settled a feud with the American inventor, jettisoning his claim to his prior unpatented invention in order to validate Edison's 1879 patent (Hannah 1979).

These combined technological innovations resulted in the rapid expansion of electric lighting by facilitating the production of electricity on a commercial scale. Applications of electrical systems subsequently developed predominantly in Britain, North America and Germany where individual inventors were based. As soon as the exploitation of an idea became feasible, national and international firms were established to exploit specific patents (Byatt 1979). In the early 1880s electric lighting installations were becoming more commonplace, if only on an experimental basis. By 1881, the year of the Electrical Exhibition at Crystal Palace, installations could be found in factories, railway stations, ships, country houses, theatres, clubs and other public and private arenas, predominantly in London (Byatt 1979)[8].

One of the most significant of these installations was at Cragside at Rothbury in Northumberland, the private residence of the wealthy industrialist William Armstrong. The 6hp installation drew water from one of the estate's lakes almost a mile from the mansion which Armstrong had constructed in 1870 to increase the water-power potential of the estate (The National Trust 1992). This was used to drive a Siemens dynamo which initially powered an arc lamp in a picture gallery in 1878. However, due to the practical limitations of arc lighting this was replaced in 1880 by Joseph Swan's incandescent lamps in what Swan considered 'the first proper installation' of electric lighting (The Electricity Council 1973a; Short 1991; The National trust 1992).

[8] See '1881', *The Electrician*, 7 January 1882, 120-123; '1881', *The Electrician*, 14 January 1882, 136-139; '1881', *The Electrician*, 21 January 1882, 152-155

In addition to its significance to the history of electric lighting, Cragside also holds its place in history as the world's first hydro-electric power station. The historic installation is perhaps attributable to the engineering activities of the house's owner who through this exhibition of hydro-electricity combined his twin fascinations of electricity and water-power (The National Trust 1992). In 1845 Armstrong had delivered a paper entitled 'On the employment of a column of water as a motive power for the propelling of machinery' to the Literary and Philosophical Society of Newcastle upon Tyne (Armstrong 1845) thereby illustrating an enduring interest in the use of water power, significantly earlier than the installation at Cragside in 1870.

At this juncture Armstrong presents us with a significant figure in the history of hydro-electricity for it was his enthusiasm for the new technology which pushed the barriers of electrical application forward. Armstrong had first experimented with water-power technology in 1842 when he invented his first 'hydro-electric machine' after he discovered that static electricity could be produced from the friction of water droplets on a boiler, an experiment which was responsible for his election as Fellow of the Royal Society in 1846 (The National Trust 1992). This apparatus signalled Armstrong's lifelong interest in electricity (*ibid.*). In an interview at his home shortly before his death, a man whose fame and fortune rested predominantly on armaments, Armstrong observed that electricity was indeed his first love and something to which although he had returned to it later in life he wished he had devoted more time (Short 1991). Pre-empting the possibilities and applications of electricity, in his Presidential Address to the British Association for the Advancement of Science, in reference to the electrical engineering field, Armstrong talked of "the immensity which lies beyond" (*ibid*: 7): For Armstrong, the opportunities afforded by the "mysteries of electricity" (*ibid*: 13) were there for the application of humankind, opportunities which as yet were unknown, but awaiting discovery.

The example of Cragside is useful at this stage to illustrate a salient point regarding hydro-electric development during this period. Despite the use of water to power the installation, even a decade after its first exhibition, it was the demonstration of *electric light* that warranted its reportage; the use of water-power was seemingly incidental. This is illustrated by an article published in 1881 in *The Graphic*, an illustrated weekly journal, which reported on Joseph Swan's upgrade of the electric lighting installation at Cragside. The demonstration warranted a full page illustration accompanied by a column of text and additional technical diagrams (see figure 4.1). The series of prints included an illustration of Cragside within its landscape surroundings to which the significance of both water and engineering to the residence is alluded through the depiction of a river and what appears to be an ironwork bridge in the foreground to the house. Although the series of sketches also included an illustration of the water turbine that powered the system no further mention is made of the source of power. Instead emphasis is placed on the technical particulars, brilliance and superiority of Swan's incandescent electric lighting system over the earlier arc lighting installation as the majority of images focus on the siting of individual lamps which work to suggest through the positioning of for example, one particular lamp in a bay window, the ability of the new facility to imitate natural light[9]. The description of the installation in *The Graphic* also reflected the Victorian sensibility for efficiency and economy as great merit was awarded to Armstrong in the system's use of the existing gas lamps, an aspect of the installation described as a "happy adaptation"[10]. The distinguishing features of the system were thus "its extreme simplicity, the durability of the carbon filament, and the economy with which light was produced"[11].

These developments in hydro-engineering were also the result of a further technological advancement in the form of the *turbine* which had greatly expanded an already established tradition of water-power in Britain from the mid-nineteenth century (Tucker 1976). The water turbine first originated in the early nineteenth century with further developments over the proceeding decades. By the late nineteenth century it was considered *the* most economical water-motor of its day (see Grierson 1881). This technology coupled with an indigenous coal supply and the development of the incandescent lamp also facilitated the development of *steam*-powered central stations for the public supply of electricity in the late-nineteenth century which greatly out-numbered hydro-electric stations[12].

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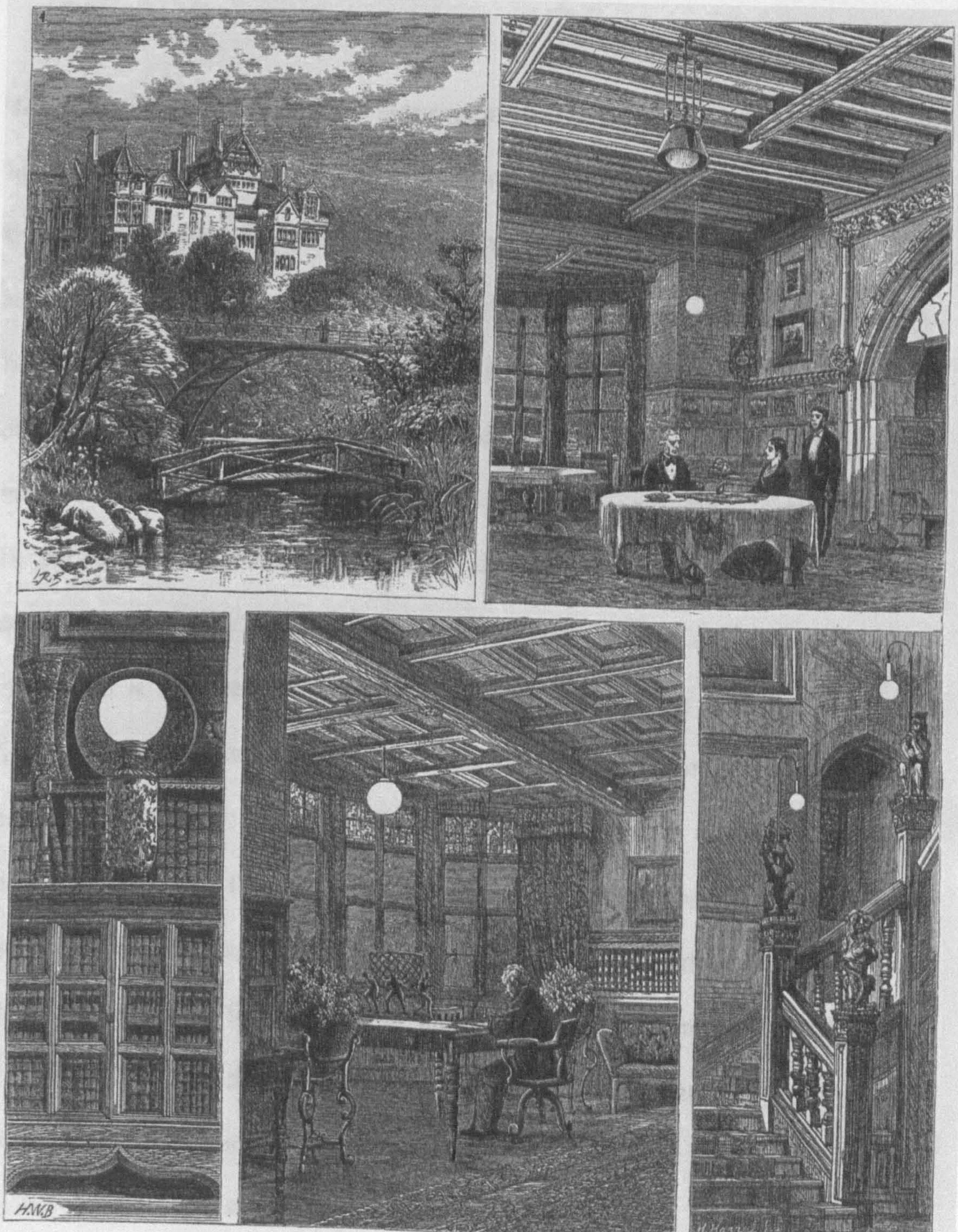
[9] These additional sketches were taken from H.H. Emmerson, evidently a favoured artist of Armstrong, whose work he had amassed a sizeable collection at Cragside (see The National Trust 1992)
[10] 'Swan's Electric Light at Cragside', *The Graphic*, 2nd April 1881, 327
[11] *Ibid.*
[12] See 4.2



1. View of Cragside.—2. The Dining Room.—3. The Library.—4. The Bay Window in the Library.—5. The Staircase.

ELECTRIC LIGHTING BY THE SWAN SYSTEM AT SIR WILLIAM ARMSTRONG'S RESIDENCE, CRAGSIDE

Figure 4.1 Illustrations of Swan's electric lighting installation that appeared in *The Graphic*

Source: *The Graphic*, 2nd April 1881

4.1.2 The Socio-Cultural Demand for Electricity

The technological advances and subsequent innovations of the nineteenth century had brought about a cultural shift in the Victorian sensibility that came to imagine that it was possible to demand new and improved facilities and amenities. This extended to superior forms of artificial lighting, a field in which there gradually became a commercial prospect for a new alternative. Prior to the introduction of electric light the most common forms of domestic illumination were paraffin lamps and candles and since the beginning of the nineteenth century the gas lamp. By the 1880s Byatt (1979) states that public gas supply was extensive (1½ million consumers compared to 6 million dwellings). However, it was also comparatively cheap and it is generally agreed that like any developing technology electric lighting remained more expensive than gas lighting until the end of the nineteenth century (Byatt 1979; Hannah 1979). However, it must be noted that this was widely disputed and the debate regarding the comparative costs of electricity and gas rumbled on throughout the final decades of the nineteenth century as the two industries competed for commercial supremacy (see for example Grierson 1881; Lane-Fox 1882). Predictably, the introduction of a new lighting technology had very much antagonised the gas companies leading to an acute level of commercial rivalry between the two industries. Amongst other arenas, these debates were often played out through the trade press of which the electrical engineering industry boasted several weekly publications. These included *The Electrician*, *The Electrical Engineer* and *The Electrical Review* each of which served as forums for the discussion of all matters of electrical engineering, including electric lighting.

Each also included news of individual electricity stations which were increasing in number with rapidity.

To illustrate these industrial relations, as part of an annual review of the electric lighting industry, the following appeared in a weekly electrical engineering trade journal:

> Our contemporaries, the papers devoted to gas interests, are in a somewhat similar plight to the man who has eaten too much lobster for supper – rather crabbed. They evidently desire to veer round, so as to become the organ of electric lighting interests, for their columns are from week to week devoted more largely to the subject. Yet, feeling that the electric light may possibly be a failure, and that it is impolite to be off with the old love before safely on with the new, they never hesitate to question the accuracy of the figures as given for the cost of electric lighting. The statement is however that the cost of electricity … is a matter which is unassailable[13].

This particular example involved the relative price of gas, but it was a matter of inevitability that the gas industry would eventually have to accept that electric lighting was superior in both illumination and convenience of use, something which engineers such the Irish civil engineer Thomas Grierson predicted as early as 1881: In an article on 'Electric Lighting by Water Power' Grierson forecast

> That the electric light will, at all events, be the light of the near future for public thoroughfares, railway termini, and the lighting of large areas generally, few who

[13] '1881', *The Electrician*, 7 January 1882, 121

have given the subject any consideration at all will deny – excepting, perhaps, those who being holders of "gas shares" are naturally interested for the success of gas lighting (Grierson 1881: 105).

Grierson's conviction in the potential of electric lighting and inevitability of its succession over gas evidently antagonised the gas interests. Whether his belief in the merits of electric lighting was commercial optimism or an educated industrial prediction, this statement highlights the fierce competition that existed between the gas and electric industries towards the close of the nineteenth century. Regardless of the gas industry's weakening grip on the domestic lighting market, there is no doubt that it had evidently done much to improve the standards of domestic illumination, negating the need for candles, wick and tallow.

The technological advances of the nineteenth century had created a growing appetite for stronger illumination at night than gas lighting could provide. By the early 1880s the experience of the few electric lighting demonstrations already installed was that it produced a softer, steadier and more brilliant illumination (see for example Grierson 1881). Coupled with this dissatisfaction with the luminance of gas, issues of safety and convenience of use were also a concern. Gas lighting was particularly problematic in enclosed public spaces such as theatres where it tended to raise the atmospheric temperature (see Grierson 1881). This was perhaps less of a problem in winter but in summer clearly undesirable. By comparison, electric incandescent lighting did not heat or vitiate the atmosphere or blacken decorations such as oil paintings and gilding as gas lighting could (Grierson 1881; Byatt 1979). Such factors led to a general disgruntlement with gas lighting which was increasingly viewed as an outdated technology (Byatt

1979; Hannah 1979; Haveron 1981). However, aside from these practical considerations gas lighting presented a more serious problem to those who witnessed it due to its perceived effects on human health. In enclosed public spaces gas tended to drain the oxygen from the air causing people to feel both nauseous and drowsy (Grierson 1881; Byatt 1979; Haveron 1981), an aspect of gas lighting that had been the subject of much public concern. For example, in reference to public lighting the *Daily Telegraph* described gas as "a noxious, explosive vapour like carburetted hydrogen"[14]. Similarly witnesses of a House of Commons Select Committee concurred that gas produced "vitiated air … largely formed by the products of the combustion of ordinary luminants" (House of Commons Select Committee 1879: 4). However, as the following example illustrates, despite a general perception that electric lighting was safer to public health, the precise scientific nature of electricity remained a source of confusion:

> A few days ago, in one of the theatres with electric lighting, we chanced to overhear a conversation between an elegant lady and two well-spoken gentlemen in the row behind us.
>
> 'Look', said the lady, 'the gas flames are upside down.'
>
> 'You are mistaken, my dear', replied her husband, 'they are electric lamps!'
>
> 'Yes indeed', explained the third, 'they are Edison lamps.'
>
> 'That's nice', said the lady, 'but if one of those lamps were to break, would it still give out light?'
>
> 'I don't think so', replied her husband, 'because then it would no longer have any electricity.'
>
> 'Ah, then the electricity is in the chandelier?'

[14] *Daily Telegraph*, 30 September 1881

'Of course.'

'No', said the second gentleman, 'the electricity is in the cellar or behind the sets, and it gets into the lamps via the wiring.'

'But tell me', exclaimed the lady, 'if one were to break a wire, would the electricity leak out into the auditorium? Wouldn't that be dangerous for the audience?'

'My dear wife', said her husband, bringing the conversation to an end as the performance began, 'one can breathe electricity without the least danger. And in any case, it would rise and collect under the ceiling at once, so we would have nothing to fear'[15].

As this albeit fictional account of a conversation between French theatre-goers attests the mystification over the nature of electricity evidently elicited some interesting theories. Nevertheless, the example serves to demonstrate the existence of a wider discourse of public lighting and health and the relative concerns over gas and electricity as sources of artificial light.

Gas, as a source of artificial lighting, connected to discourses of public health, a pre-occupation within nineteenth century society, through its perceived ability to create 'bad air'[16]. Victorian imaginings about the connection between environment and health, specifically air, held that disease was caused by inhaling air that was infected through exposure to corrupting matter (Halliday 2001), a concept otherwise known as 'miasmatic theory' (see Driver 1988). Although this was a perception which predominated in the early Victorian period as a result of

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[15] L'Electricité, *Revue Scientifique Illustre*, 1 January 1887 in Schivelbusch (1988: 76)

[16] Driver (1988) argues that concerns over public health had come about due to an increasing awareness of environmental science stemming from the European Cultural Revolution at the end of the previous century coupled with an increasing availability of environmental data.

the cholera epidemics between 1831 and 1866, and was gradually discredited after the work of John Snow (see section 4.1.3) and then William Farr, it was a belief which survived into the early twentieth century (*ibid.*).

Despite a general lack of scientific understanding, given the practical and environmental concerns over gas lighting there was an assumption that a conversion to electricity was desirable. Furthermore, the instalment of electric lighting in the haunts and residences of the wealthy had helped to position electric lighting as an early example of an 'aspirational good'. Hannah (1979) records that Swan's installation of a system of incandescent lamps in his own house at Gateshead had led to the new amenity becoming a symbol of wealth. Testimonials in the trade journals demonstrate a great enthusiasm and appetite for the introduction of electric light (see for example Lane-Fox 1882), partly as a result of the growing dissatisfaction with gas; partly due to the novelty of the technology. However, this was a consensus found beyond the pages of trade journals as articles discussing the new technology also appeared in the local and national press. In capturing the cultural zeitgeist, a report of the debating of the Electric Lighting Bill which appeared in *The Electrician* quoted one member of the House of Commons as describing the country as "wild about electric lighting"[17], thus illustrating this demand for the new facility; one driven by new social and cultural aspirations, a condition of Victorian society which, as examined below, extended beyond the material to the physical environment.

[17] 'The Electric Lighting Bill', *The Electrician*, 22 July 1882, 233

4.1.3 Municipal Socialism, Hydro-Electricity and Civic Improvement

The introduction of electric lighting however was not simply a response to a demand for superior forms of illumination. The implementation of public electricity supply systems to towns and cities in late-nineteenth century Britain built on the Victorian tradition of civic improvement, both a central characteristic of the Victorian sensibility (Rosen 1973; Schoenwald 1973; Wohl 1973) and an important aspect of the Victorian legacy: political historians have argued that many of the functions of urban space in the twentieth century stem from the Victorian approach to civic governance, i.e. municipal socialism (Fraser 1976). As explained earlier, many towns and cities in Britain had benefited from gas lighting in public spaces for much of the nineteenth century, but technological improvements in electric lighting heralded a further form of urban advancement to address not only the physical, but also the social and moral restitution of towns and cities in an ever technologically modernising Britain[18].

The practice of civic improvement was partially a reaction to the growing urban population brought about by the Industrial Revolution from the mid-eighteenth century. Industrialisation coupled with the depression of British agriculture from the 1870s had brought Britain's rural dwellers to the cities in their droves in search of work. The continued industrialisation of Britain by the mid-nineteenth century had resulted in massive overcrowding of Britain's towns and cities which were designed to cope with smaller and less densely habited populations. To illustrate this growth, prior to the period of industrialisation in the eighteenth and

[18] Public gas lighting was inaugurated in Nottingham for example in 1819 (WRO, Worcester City Archive).

nineteenth centuries only a quarter of the British population lived in towns with a population of more than 2500 (Pawson 1978). This rapid rural to urban migration had led to a multitude of problems in public health and sanitation. They were thus wholly unprepared to receive such volumes of people: in becoming 'the workshop of the world' living conditions had worsened due to close working quarters and smaller cramped living conditions in the expanding urban milieu (Rosen 1973). Lack of proper housing, overcrowding and inadequate environmental sanitation polluted both the streets and the water supplies. The result by some accounts was an unhygienic chaotic quagmire of stench, filth and disease. As Schoenwald (1973) rather graphically describes, the cities were "full of the stench of rotting human and animal detritus; horse droppings accumulated in the streets; human faeces lay heaped in slum courts or beneath dwellings" (*ibid.*: 671). This situation led to the development of the miasmatic theory which reached its zenith in the work of the social reformer Edwin Chadwick. Miasmas were said to be invisible atmospheric substances generated by both the putrefaction of organic matter and the human body in the course of daily living (Driver 1988). Coupled with the Hippocratic treatise that disease was related to *Airs, waters and places* (Driver 1988) the idea of an inextricable relationship between the physical environment and human health was integral to Victorian perception of the urban environment.

The way the Victorians chose to respond to the growing urban problem reflected a unique environmental sensibility concerned with *the regulation and control of space*, a practice which incorporated ideas of order, efficiency and an increasing awareness of the natural environment and humanity's relational place therein. The Victorian environmental vision therefore was concerned with the regulation and cleansing of the physical (primarily urban) environment, for the amelioration of public health and disease. The realisation of the ever-growing problem of public health and dire sanitation in the country's urban settlements therefore resulted in a program of *amelioration*, to be achieved through a system of sanitary reform. The Victorian pre-occupation with regulation is illustrated by a growing concern with statistics and social survey reflected in the establishment of statistical societies in London, Manchester and other towns in Britain which aimed to provide information about a rapidly changing society (Driver 1988). These sentiments extended from the European Enlightenment ideals of the end of the previous century (Fraser 1998); an intellectual revolution which coincided with a scientific revolution that promised to expand knowledge and argued that systematic thinking could apply to all forms of human activity. The combination of new ideas about science and those about the control and regulation of space combined to create news ideas about improvement: British Victorian society was not prepared to allow the environmental and social deterioration of its towns and cities.

Not only can the Victorian's be attributed with the practice of urban improvement, they were also responsible for the new system of governance through which it was achieved. The municipalisation of cities which occurred across Britain through a series of Parliamentary Acts[19] over the course of the nineteenth century demonstrated a system of governance which was also central to the Victorian ideology. In response to essentially local pressures Victorian urban Corporations gradually assumed responsibility for the welfare of citizens

[19] See for example the Reform Act 1832, the Municipal Corporations Act 1835, the Municipal Corporations Act 1882, and the Local Government Act 1888.

(Byatt 1979) a phenomenon later characterised as 'civic governance' and an example of Victorian paternalism. From the early nineteenth century many towns and cities had established their own town councils as a way of managing the expanding urban environment and the public health crisis that the new industrialisation had brought. 'The Municipal Ideal' (Fraser 1998), the idea that urban improvement should be the responsibility of the Town, was actively advocated by social reformers such as Edwin Chadwick and Joseph Chamberlain who attempted to address the urban squalor of cities such as Birmingham, Manchester and London as a means of benefiting the urban populace (see Schoenwald 1973; Fraser 1998). For example Joseph Chamberlain's strategy of civic improvement in Birmingham was described by the Editor of the *Birmingham Daily Post* as 'a highly organised and well-administered system of communal effort ... ordered association for the common good' (in Fraser 1998: 172).

Joseph Chamberlain (thrice elected Mayor of Birmingham before being elected to Parliament in 1876) presents us with a significant figure in the history of civic governance and within that domain, the history of public electricity supply. In a biography of the industrialist and social reformer, Fraser (1998) imparts that prior to the 1860s the status of councillors was low and the local elite looked to philanthropic rather than municipal outlets for their displays of public service. The arrival of Chamberlain in the 1860s however led to the appointment of several wealthy industrialists, businessmen and professionals to town councils. This had the effect of significantly altering the composition of the Council, augmenting its organisational ability and enlarging its vision, which Fraser argues led to a 'civic renaissance' that elevated the status of the Town Council (and those who operated within it). At the heart of this renaissance lay the twinned municipalisation of gas and water, a political philosophy characterised as 'municipal socialism'. By the end of the nineteenth century public gas supply had become a standard municipal initiative (Fraser 1998). Such was Joseph Chamberlain's commitment to civic improvement he later became Chairman of the Board of Trade, in his position as which he was responsible for bringing to fruition the Acts of Parliament that facilitated the implementation of public electricity supply (see section 4.1.4). The municipal control of electricity supply built on the previous achievements of the system of civic governance which had characterised the provision of gas and water (Robson 1935)[20]. Byatt (1979) states that the reason for this was that local authorities were well placed to operate electrical utilities: the area covered was small and local authorities were able to tap the capital market and the problems concerning the use of streets.

The advent of civic hydro-electric power in Britain connects to the wider consideration of water and the urban environment in nineteenth century Britain. The municipalisation of water meant that its supply and control became a primary function of local authorities during the second half of the nineteenth century. Given its linkages to sanitary science, a discipline which examined the urban geography of disease, its relationship with local environmental conditions and location, distribution and migrations of the population (an approach which rested on miasmatic theory), issues of water were at the heart of municipal governance. Undoubtedly supported by the new scientific knowledge central to the European

[20] Not all schemes were operated by town councils. Private enterprise also characterised the first hydro-electric schemes in Britain. See 4.2.

cultural revolution of the late eighteenth century, water supply was very much linked to issues of public health and proved a topical subject of discussion amongst opinion-makers of the day as evidenced in contemporary publications[21]. Despite its limited distribution at the time, the work of scientists such as the epidemiologist John Snow who published his historic text on the transmission of Cholera in 1849 with a second edition six years later, contributed to a growing public awareness of the links between public health, water and sanitation[22]. Through these discourses of public health, in addition to the social reformist ideas of Chadwick and the sanitary movement, notions of water became inextricably linked to those of public health and sanitation (Fraser 1998; Roberts 2006). Given this theoretical connection, it could be proposed that an electricity supply system powered by water invoked the idea of 'cleanliness' within the practice of the provision of public lighting which no doubt reinforced the idea of electricity as 'healthy' over its 'noxious' gas rival. However, it must not be ignored that aside from these theoretical considerations, prior to the twentieth century water was an orthodox source of motive power for industrial processes, so where it was available, for local authorities it made economic and logistical sense to utilise the resource. In late nineteenth century Britain the use of water for the production of energy was received as novel but never extraordinary.

The civic improvement of Britain's town in cities evidently aimed to address the condition of the country's urban environments. But, as intimated earlier, this

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[21] See Gregg International Publishers (1973). *Public Health in the Victorian Age*, Westmead, Hants: Gregg International Publishers Ltd.; Westminster Review (1856), 'Drains, rivers and water supply', *Public Health in the Victorian Age, Volume I*, Westmead, Hants: Gregg International Publishers Ltd.

[22] See Snow, J., 1849, *On the Mode of Communication of Cholera*, London; Snow, J., 1855, *On the Mode of Communication of Cholera* (2nd edit), London

program of 'amelioration' extended beyond the physical decay of the city. The mass industrial migration witnessed from the end of the eighteenth century brought with it not only a deterioration in the physical environment but also in the social and moral health of its occupants. In a paper on moral geographies and the Victorian urban environment which examines the relationship between environmentalism and moralism, Felix Driver (1988) states that the Victorian practice of urban improvement which influenced the control of the physical environment necessarily extended to the amelioration of the Victorian moral condition. Miasmatic theory extended to the idea of *moral* miasmas; conditions such as pauperism, crime, ill-health, drunkenness, delinquency and degeneracy were characteristics seen as part of a wider syndrome of anti-social behaviour. These correlated with the sanitary deterioration of the physical environment found in the streets of Victorian Britain, an environmental state which commentators argued precluded 'health and virtue' and thus influenced its distribution (Driver 1988). The lighting of public space directly correlated with the endeavour towards social improvement by deterring such anti-social behaviours. The lighting of the streets by night went some way to addressing the needs for the 'moral sanitary regulation' of the urban environment discussed by Driver (1988), as it to some extent constituted the *control* of space at night and thus the control of social behaviour and more importantly *mis*behaviour.

Building on this idea, the relationship between the introduction of public lighting and the control of social morality is explored in greater detail by the cultural historian Wolfgang Schivelbusch (1988). In his historical analysis of the advent of electric lighting in late nineteenth century Paris, Schivelbusch argues that the lighting of the city streets (initially through gas lighting) acted as a deterrent to the perceived social ills of Victorian urban society described above. Schivelbusch argues that the lighting of public spaces by electrification addressed not only a physical impracticality in the need to be able to see after dusk, but also a psychological barrier to darkness and the night. As Schivelbusch (1988) documents, throughout the preceding centuries, the hours between dusk and dawn were seen as a time to be feared, when public spaces were in need of protection and patrol. Up until the end of the eighteenth century it was general practice for people to be confined to their houses after the hours of darkness, a psychological barrier which the illumination of the streets served to break down as it removed the predator in the guise of darkness and brought a sense of order and structure to the otherwise darkened outside world. Further to this, Schivelbusch (1988) notes that in the late seventeenth century the lighting of gas lamps fell under the jurisdiction of the police as an extension of its order and control of public space. If it is to be accepted that street lighting was a measure that contributed to the maintenance of moral order rather than simply 'lighting the way', it makes sense that the organisation and delivery of public lighting became centrally controlled, seen as part of a public duty exercised by the authorities.

As a corollary to morality, the practice of urban improvement which encompassed the introduction of public lighting connected to ideas of religious virtue. Political activity through civic interest and improvement was linked to religious service. For example, during the mid-nineteenth century, in Birmingham, the religious orator and unorthodox pastor George Dawson urged believers to express religious conviction in terms of civic duty and he increasingly identified the municipal corporation as the modern expression of 'God's will' (Fraser 1998): through civic improvement the town was the beneficiary of religious philanthropy. Similarly, the Birmingham Congregationalist minister Robert Dale pleaded with his congregation to "see to it that the towns and parishes in which they live are well drained, well lighted and well paved" (Fraser 1998); a type of oratory that Fraser (1998) described as 'civic gospel'.

As an extension of this type of morality there was also a more *symbolic* connection between artificial lighting and ideas of religion. Returning to the example of the introduction of electric light in Paris, Schivelbusch (1988) discusses how electric lighting in the streets of the city was deified; a concept the author posits as "electrical apotheosis" (Schivelbusch 1988). Schivelbusch (1988) explains that in nineteenth century Paris, electric light was received with great wonder and enchantment; a symbol of welcomed modernity, witnessed as the 'stuff of fantasy' and mystification. This theological connection between electric light and 'the Gods' was related to the idea of the sun, itself often a theological concept as a bringer of light. As Schivelbusch explains:

> Nightfall brings forces very different from those that rule the day. In the symbols and myths of most cultures, night is chaos, the realms of dreams, teeming with ghosts and demons as the oceans teem with fish and sea monsters. The night is feminine just as the day is masculine, and like everything feminine it holds both repose and terror. For the mythic imagination, night and deluge are closely related. They are two sides of the chaos from which Jewish, Egyptian and Babylonian creation myths, the world – light and dry land – came forth. Every time the sun rises, the world and the light are created anew; in every sunset the world and the

> light, the sphere of solidity and Apollonian masculinity, again descend into the flux of darkness (Schivelbusch 1988: 81).

The artificial lighting of the outside world beyond the limits of natural light, addressed the fear of the outside world after dark as it removed the darkness, synonymous with fear, and suspicion of those acting under its shield (Schivelbusch 1988) bringing structure and order to an otherwise chaotic and threatening darkened world and thereby changing how and when public space was used. Light, or the absence of it after dusk, as William O'Dea (1958) argues is a significant factor in socio-cultural history; an aspect that he found had been hitherto devoid of enquiry. The gradual introduction of light into the home, the work place and wider public spaces transformed the way society conducted its day to day activities both temporally and spatially and the way both public and private space was used. Although other forms of artificial lighting, namely gas, had already begun to effect these changes, it was the development of *electric* light which acted as the main catalyst to changes in the use of public and private space from the late nineteenth century.

4.1.4 The Electric Lighting Acts 1882 and 1888

As a result of both the enthusiasm for electric light and the developing technology, from the early 1880s the public supply of electric lighting began to expand. Pivotal to this expansion were the Electric Lighting Acts of 1882 and 1888. The growth of the electric lighting field, evidenced by both the number of electrical engineering companies established in Britain and the volume of private bills requested for ad-hoc public supply stations (Byatt 1979; Hannah 1979), necessitated a comprehensive legislature to regulate the new industry which was provided in the two Acts[23].

Stimulated by innovations in electric lighting technology during the preceding decade, in 1879 a House of Commons Select Committee was appointed to consider the desirability of authorising Municipal Corporations or other local authorities to adopt any schemes for lighting by electricity, and to consider how far, and under what conditions, gas or other public companies should be authorised to supply light by electricity. The committee was chaired by chemist and politician Dr Lyon Playfair who was aided by a variety of distinguished individuals; the scientific witnesses consulted included notable scientists and electrical engineers including Faraday's successor as advisor to the Board of Trade Sir John Tyndall, the electrical engineer Alexander Siemens and William Henry Preece, chief engineer to the GPO.

Despite its support for the development of electric lighting, it was recognised by all who gave evidence that the technology was still very much in its experimental stages and not yet at a point where it could compete with gas in the supply of power to individual premises. The resulting legislation was thus instigated to facilitate the further development of the technology which despite the recognised infancy of the industry was seen to be developing with "remarkable rapidity"

[23] According to Byatt (1979) the 1880s was a period when Parliament experimented with methods of public utility regulation which had similarly been passed for the control of other public utilities.

(House of Commons Select Committee 1879: 4)[24]. At this stage, as far as Parliament was concerned the resulting schemes would be experimental and emphasis was therefore placed on the limitation of powers. As independent bodies, it would be the municipal powers that would be enacted to operate the schemes. However, given the event that the industry became established, powers would then be offered to private companies to also apply for licences to operate schemes. As far as the gas companies were concerned it was considered that they had no monopoly on the lighting of public streets or private houses so experiments should be open to local authorities (and electric companies empowered by them) only. Besides, it was the educated opinion of the scientific witnesses of the report that "electric light committed to [the care of gas companies] might have a slow development" (House of Commons Select Committee 1879: 4).

The Select Committee concluded that the development of electric light was considered of utmost importance for the future of both public and private illumination in which it was predicted to play a leading part and that legislation should be enacted to facilitate this (see House of Commons Select Committee 1879). The scientific witnesses saw as a result of the development of electric lighting "the means of great industrial development" (*ibid.*: 4). The Committee also predicted that it would have a significant bearing on the future of industry due to the ability of electricity to transmit power (House of Commons Select Committee 1879). Given the perceived significance of the developing technology to both industrial and domestic milieus, the Committee must therefore have

[24] Although there were those who argued that the industry had stagnated over the past thirty years. See for example Williams, M., 'Electromania', *Knowledge*, 21 July 1882, reprinted in *The Electrician*, 5 August 1882, 272-273

considered it their political responsibility to recommend the development of legislation to facilitate the evolution of electric lighting.

The importance of the introduction of electric light was felt not only by the scientific witnesses involved in the above inquiry but also in subsequent Parliamentary debates. The rescheduling of the debating of the Bill in July 1882 from a Friday to a Saturday morning session was sufficient to upset some members in attendance. One Colonel Makins, MP for South Essex[25], was of the opinion that the Bill was of much greater importance than to only be heard by the reduced attendance as was usual for a Saturday morning session compared to a usual weekday session due to the curtailment of a full discussion. He stated that although he "did not want to throw any obstruction in the way of progress ... one of the points involved in this Bill was so novel and so important that it ought to be discussed in a full House"[26]. The novelty and importance of the Bill as Colonel Makins saw it was unfortunately not recorded. Neither was Colonel Makins' point elucidated in the report of the debate which later appeared in *The Electrician*[27].

As the industry was still considered experimental, the purpose of the legislature was fundamentally to allow the electrical industry to develop the technology to furnish the public with an electricity supply by providing the facilities for Companies or individuals to conduct the necessary experiments to get to this point "in the simplest and cheapest manner"[28]. The Electric Lighting Act was subsequently enacted by Royal Assent on 18th August 1882. The Act enabled

[25] 'The Electric Lighting Bill', *The Electrician*, 22 July 1882, 233-236
[26] Hansard Volume 275, July 13th 1882, page 417.
[27] See 'The Electric Lighting Bill', *The Electrician*, 22 July 1882, 233-236
[28] Hansard Volume 275, page 569 August 3rd 1879

intending suppliers to apply for licenses referred to as 'Provisional Orders' to lay mains under the streets and thus legal powers to supply electricity. Although some previous installations had used overhead cables or mains cabling laid openly in the street, most suppliers had found that underground cabling worked better from both an aesthetic and practical point of view (Hannah 1979). The act thus allowed for the breaking up of the streets by private companies or local authorities for this purpose[29]. In order to protect the public against the power of private monopoly, the Act also provided for maximum prices and the purchase by local authorities of companies established under the Act after twenty-one years (the reversionary purchase rule), clauses that came directly from the Select Committee's report[30]. The experience of the gas industry in which gas companies had developed huge monopolies caused concern amongst the Lords who placed great importance on preventing such a situation repeating itself with the electric lighting industry hence the emphasis on the limitation of powers.

The passing of the Act was followed by mass application for Orders; in the first month after the Act was passed nearly eighty applications were received. However, despite the fact that by 1888 up to seventy-four Provisional Orders had been issued, these powers were never exercised (The Electricity Council 1973a; 1973b; Byatt 1979; Hannah 1979)[31]. The problem lay in the license period of twenty-one years, which it has been argued, stifled the electrical supply industry because it deterred private investors from committing their capital to the emergent

[29] A previous Act of 1847 had set a precedent by allowing for the breaking up of the streets for the purpose of laying and repairing pipes for the supply of gas (The Electricity Council 1973b).
[30] The 1870 Tramway Act had inaugurated the system of granting limited-period franchises; the big towns had begun to buy up gasworks and waterworks (The Electricity Council 1973b).
[31] Limited development did take place however by companies avoiding the Act by obtaining permission from local authorities to use overhead cabling (Hannah 1979).

industry (Tucker 1976; Byatt 1979; Hannah 1979). Consequently, on 28th June 1888 a second Act was passed which extended the limited period from twenty-one to forty-two years making it attractive, for the first time in Britain to invest in the field (Tucker 1976). This sentiment was voiced from within the industry for example by the Anglo-American Brush Electric Light Corporation which felt that the removal of this impediment would be "of material benefit to the industry"[32]. The Company was of the opinion that this would "prove a turning point in the history of the industry" and lead to a "long anticipated revival in the Electric Lighting business"[33]. Consequently, from around 1890 electricity supply in Britain began to expand.

4.2 Hydro-Electric Stations in Britain 1881-1900

4.2.1 D.G. Tucker and the History of Hydro-Electricity for Public Supply, 1881-1900

Section 4.1.4 demonstrated how the development of electricity stations in the 1880s was greatly facilitated by the Electric Lighting Acts. However, ad hoc development of electricity generating stations had been witnessed since 1881. Although the majority of these generated electricity from coal-fuelled steam-power a handful were powered by water. In the mid-1970s, Professor D.G. Tucker, using archival sources, oral histories and reports published in the trade journals *The Electrician* and *The Electrical Engineer*, conducted what he claimed to be a definitive survey of water-powered public electricity supply in England

[32] Letter from the Brush Electric Light Corporation to its shareholders, Devon Record Office
[33] *Ibid.*

between 1881 and 1894[34]. The resulting report was published in the *Industrial Archaeology Review* in 1976 (see Tucker 1976). Employed by the Post Office Engineering Department since 1932, principally in line transmission and carrier telephone systems, from the 1950s Tucker worked as an academic; from 1955 to 1973 as Head of the Electronic and Electrical Engineering Department of the University of Birmingham[35]. His personal research was mainly in underwater acoustic systems but his interests extended to the general history of Engineering a subject on which he published over 300 articles (Bonson 1999). As well as the history of public electricity supply, he had written extensively on the histories of both telephony and railway engineering with a particular focus on the late-Victorian period[36]. Despite an emphasis on the technological specifications of each scheme, as discussed in chapter 3 Tucker (1976) provides a sound factual foundation by delineating the schemes in operation and the basic social, cultural and economic context to the advent of public hydro-electric supply in late-nineteenth century Britain, as well as identifying relevant primary material.

By 1881, hydro-electricity was becoming a more commonly practised source of energy for *private* developments for the lighting of industrial, private and commercial premises. Although he doesn't record them in the article Tucker (1976) finds records for up to fifty such installations between 1881 and 1894. Hydro-electricity for *public* electricity supply purposes however was much less common, totalling nine for the same period (Exell 1974; Icely 1974; Tucker

[34] To illustrate the author's claims to have completed an exhaustive search, Tucker cites information for which he has been unable to find supporting evidence for example claims for a hydro-electric station at the Shaw Chemical Works in England in 1875 (See Carter 1960).
[35] Ed., (1989) 'Obituary Notices', *Transactions of the Newcomen Society*, 61, 109-112. Tucker died in 1989 aged 75.
[36] See for example *Transactions of the Newcomen Society* (www.newcomen.com); Bonson (1999).

1976). In contrast Tucker (1976) states that there were at least ninety-one public supply stations driven by steam. Despite its increasing use, in part due to its relative lower cost compared to the more ubiquitous steam (Tucker 1976), water was a comparatively underused source for electricity generation.

For these reasons it made sense that where a generating station was proposed it should be powered by water, especially where proposed stations were remote from coalfields. Basing his assumption partially on information in the annual reports of the North of Scotland Hydro-Electric Board and records for the hydro-electric station at Worcester, Tucker (1976) states that this was probably due to existing civil engineering works. The adaptation of existing engineering works at this point in time was a consideration borne out of both economic and technological considerations: this was a case of the existing infrastructure being both available and suitable for conversion to hydro-electricity generation, rendering the overall project costs lower, rather than a self-conscious environmental statement about *re-use* (a principle synonymous with twenty-first century environmentalism).

Tucker (1976) focuses on eight schemes that became operational between 1881 and 1894. He also unearths records for a ninth scheme at Blockley but for unexplained reasons did not include the installation in his summary. The first scheme opened in 1881 at Godalming. This was followed by the opening of seven further installations between the years of 1885 and 1894. In chronological order: Greenock, Renfrewshire (1885), Wickwar, Gloucestershire (1888), Okehampton, Devon (1889), Keswick, Cumberland (1890), Lynmouth, Devon (1890), Chagford, Devon (1891) and Worcester (1894). Blockley was opened sometime during the early 1880s (see Icely 1974). Given its size and operating capacity Tucker (1976) considered the scheme at Worcester as the pinnacle of nineteenth century hydro-electricity generation. According to this rationale Tucker stopped short of researching a further six hydro-electric stations that opened prior to the end of the nineteenth century. These were at Milngavie (1894), Fort William (1896), Salisbury (1898), Monmouth (1899), Fladbury in Worcestershire and Ingleton in North Yorkshire (both 1900). Figure 4.2.1 shows the location of each of these fifteen stations from which several points of interest in the context of the historical geography of hydro-electricity in Britain can be drawn[37]. Firstly, unlike large-scale hydro-electric development witnessed during the twentieth century, these schemes were developed predominantly in England, with only two realised in Scotland and one in Wales, which by virtue of this fact meant that they were developed mainly in the British lowlands. Furthermore many of these schemes were powered by comparatively 'small' rivers which significantly, offered lower potential yields than some of Britain's larger water courses, an observation which Tucker (1976) cites in his discussion of the relative successes and failures of late-nineteenth century hydro-electric generation.

Unlike the later public supply schemes developed principally by the state, the first hydro-electric installations in Britain can be described as small-scale, this

[37] Tucker (1976) also found records for forty-five hydro-electric station that were proposed but not adopted. These were Aberystwyth, Durham (1881), Exeter (1882), Lanark (1886), Cockermouth (1887), Otley, St. Albans (1888), Ayr, Burton-on-Trent, Penrhyn, Windsor (1889), Llangollen (1890), Egremont, Elgin, Helston, Hexham, Inverness, Matlock, Bath, Plymouth, Richmond, Shipley (1891), Barnard Castle, Bridgend, Chester, Guildford, Moffat, Queensferry, Reading, Rochdale, Tutbury, Willesden (1892), Bewdley, Cardiff, Crieff, Glynceiriog, Llandrindod Wells, Montrose, Tiverton, Workington (1893), Baslow, Bromsgrove, Conway, Newby Bridge and Ulverston (1894). See chapters 5 and 9 for further discussion of failed proposals.

denoting a *local* area of supply, long distance supply, which later developed through the construction of the National Grid in 1926 (Luckin 1990) being neither feasible nor necessary (The Electricity Council 1973b). These differences in scale distinguished these early schemes from their later *large*-scale counterparts which were constructed for regional and national supply. Late-nineteenth century hydro-electric development can be further differentiated from later State-led examples by municipal trading and private enterprise. Most of the fifteen hydro-electric stations opened between 1881 and 1900 were *civic* projects developed specifically for the public lighting of the town in which they opened. These were operated either municipally or privately on behalf of the Town Council by established electric lighting companies, each varying in size and success. Emphasis was placed on municipal trading rather than private enterprise, largely because the latter was discouraged by 'the reversionary purchase clause' in the 1882 Act which aimed to protect the public against the power of private monopoly (The Electricity Council 1973a). Some installations however were more ad-hoc, operated by individual entrepreneurs or philanthropists with the resources (both financial and infrastructural) to capitalise on the newly available technology. Others, such as that at Wickwar were secondary to primarily private installations and were short-lived.

Seven of the schemes researched by Tucker (1976), and four others for which he finds records are considered below in chronological order. Despite Tucker (1976) tracing evidence for stations at both Fladbury and Ingleton, no archival records have been located for either scheme, neither did Tucker (1976) reference his sources for the two installations. However, as was custom in the late-nineteenth century electrical engineering industry, the opening of each was reported in the electrical engineering press which attests to their existence[38]. Although the fundamental particulars of each station (where known) are noted, in considering these schemes rather than providing an exhaustive account of each, I have attempted to draw out the unique or otherwise interesting aspects. Some installations bear greater significance to the history of hydro-electric generation than others and as such warrant a more detailed approach. What emerges is a story of ad-hoc development characterised by both entrepreneurship and municipal socialism. The eighth scheme examined by Tucker (*ibid.*) at Worcester is considered in more comprehensively in chapter 5, illustrating further the ideas presented in 4.1.

[38] See *The Electrical Review*, 5th April 1900 and 21st December 1900

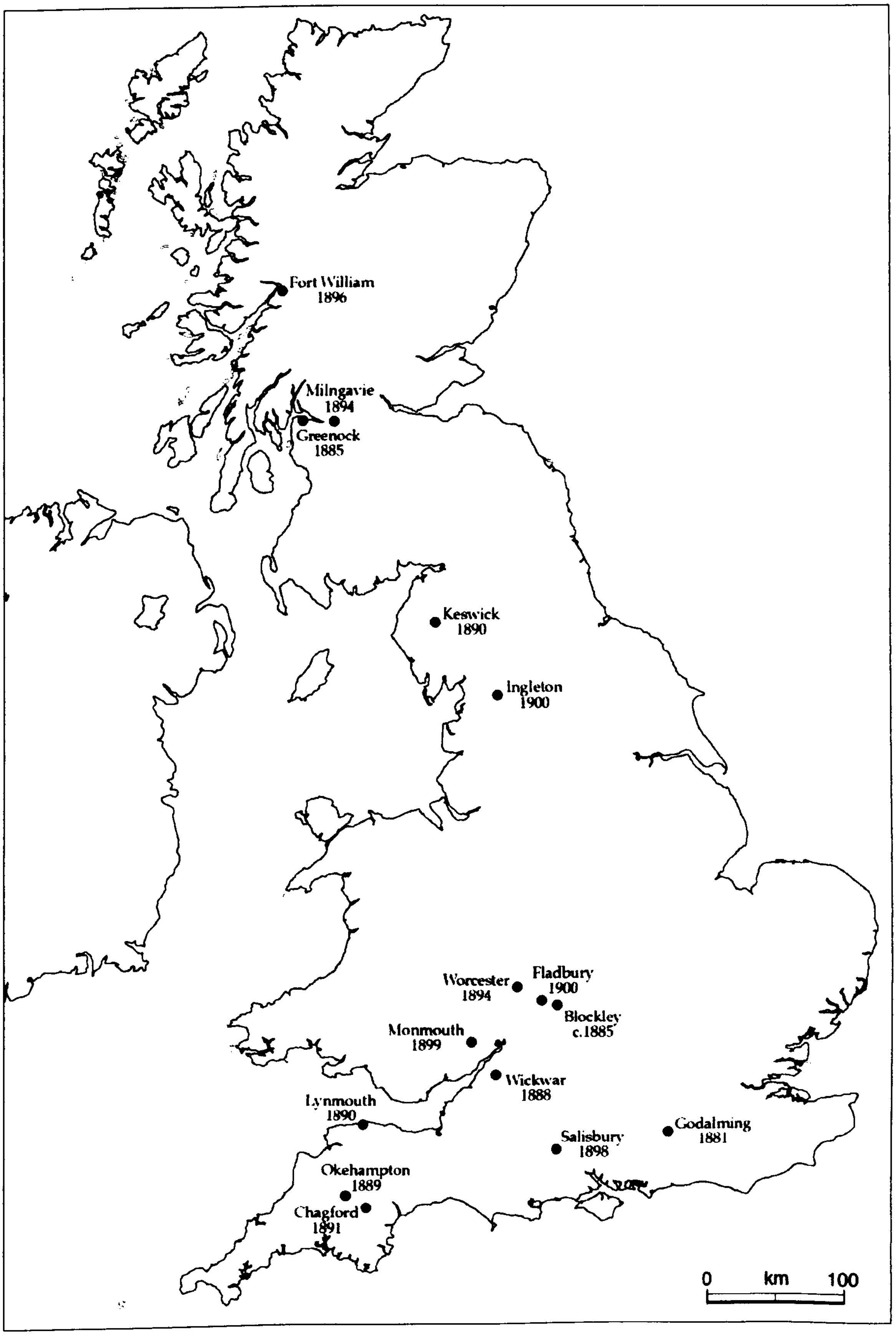

Figure 4.2.1 Map of Britain showing the locations of the fifteen hydro-electric stations opened between 1881 and 1900

4.2.2 Godalming, September 1881

The history of British electricity generation for public supply began in November 1881 with the opening of a hydro-station at Godalming. The installation set a number of precedents. Not only was it the first public electricity supply station to open in Britain, it also happened to be powered by water[39]. However, until Tucker's article in 1976, within the published history of the Godalming hydro-electric station, this fact remained largely a matter of idle curiosity and certainly secondary to its place in engineering history as the first public electricity supply station in Britain[40], its standing as which has rendered it the subject of several publications (including two commemorative centennial editions) an accolade which has eluded wider Victorian hydro-electric generation (see Strange 1979; Haveron 1981; The Electricity Council 1981).

Operated under the proviso of the Town Council the installation set a further precedent by being the first municipal scheme operated in Britain. In the summer of 1881, the General Purposes Committee of Godalming Town Council was instructed with investigating the possibilities for lighting the town by electric light[41]. On 3rd September 1881 it was reported by the *Surrey Advertiser* that:

> Arrangements have been made with a London firm of electricians to fix 2 or 3 electric lamps as an experiment. We understand the electrical lights will be shown within the coming fortnight.

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[39] See *Southern Beam* (1950); The Electricity Council (1973a); The Electricity Council (1973b)

[40] See *The Graphic* (1881); *Southern Beam* (1950), The Electricity Council (1973a); The Electricity Council (1973b), Haveron (1981).

[41] Minutes of Godalming Town Council 1881, Surrey History Centre

The firm in question was Calder and Barrett "who had already received some renown in installing electric light in important buildings" (Haveron, 1981: 3). The Company had previously worked with Siemens equipment and on their experience of the system decided to do so again. By the early 1880s, the Siemens brothers had developed an international business operating between Berlin, London and St. Petersburg (Byatt, 1979). When *Lighting by Electricity* was investigated two years earlier (see House of Commons Select Committee 1879) Sir William Siemens was amongst a handful of 'distinguished' witnesses to advocate electric light for public places. In an annual review of the industry, in reference to the work of Siemens brothers, *The Electrician* commented that "the motto of the firm seems to be ... to do work by stealth and blush to find it known"[42]. Despite the company's modesty, records for street lighting installations had been found in the London districts of London Bridge, King William-street, Royal Exchange and Poultry in addition to several large buildings in the capital including the Alhambra and Savoy Theatres thus demonstrating a distinguished portfolio of installations[43].

The turbines were to be located at the premises of E. and J. Pullman, leather dressers who occupied a large tannery at Westbrook Mill (depicted in figure 4.2.2b) north of the town centre. The geography of the scheme is reproduced in figure 4.2.2a. Messrs Pullman had made an agreement with the Town Council that the mill buildings housing the tannery would be fitted with three arc and seven incandescent lamps in exchange for the use of the motive power of the River Wey to which the leather dressers held exclusive rights. Messrs Pullman had also

[42] '1881', *The Electrician*, 14 January 1882, 136-139
[43] *Ibid.*

consented to place one of their waterwheels at the disposal of the Council to furnish the water power necessary for the light[44]. The electricity generated would be supplied for street lighting in Godalming and also lighting for nearby Charterhouse Schools and some in Guildford (Tucker 1976; Haveron 1981)[45].

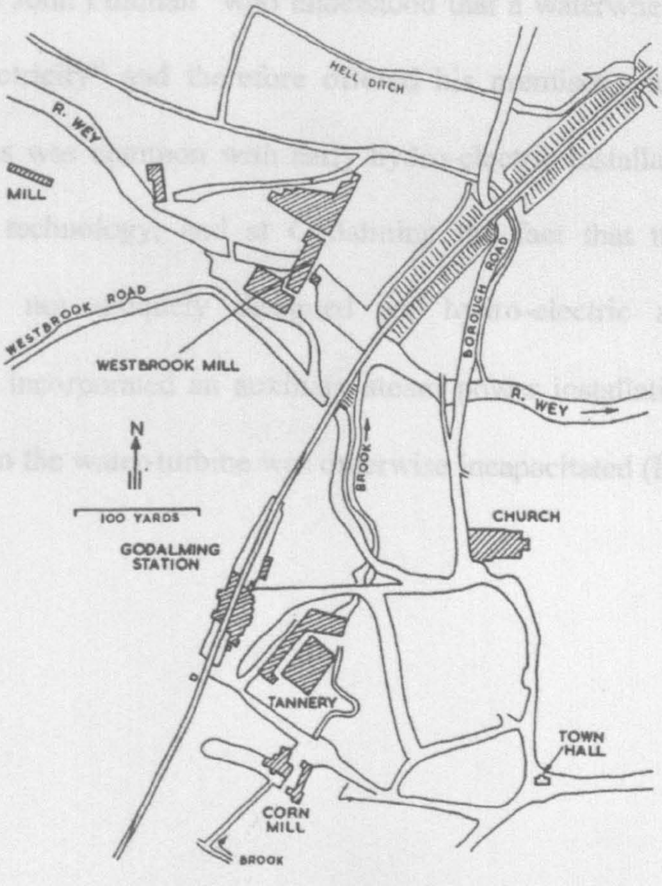

Figure 4.2.2a Sketchmap of Godalming showing the location of the hydro-electric installation at Westbrook Mill and Charterhouse School
Source: Tucker (1976)

How and why the idea of electric light was presented to the Town Council is unspecified, as is the decision to power the installation by water, although it was perhaps influenced by the "the volume of the stream being large and a fall of five

[44] *Engineering* 33, 13 January 1882, 35-6
[45] See also *The Electrician*, 1st October 1881. A report in *The Electrician* of 24th December 1881 reported that the public library and theatre would also be supplied with electric light but no further reference is made to this in the primary or secondary sources.

feet being available"[46]. The Victorian environmental sensibility drew on ideas of order, efficiency and 'not letting things go to waste', so where a cheap and easily available power source existed in the form of water, it was the obvious choice over the more costly option of coal. Haveron (1981) speculates however that the impetus for the scheme in Godalming must have come from the proprietor of Westbrook Mill John Pullman "who understood that a waterwheel could be used to generate electricity" and therefore offered his premises and works for the installation[47]. As was common with early hydro-electric installations due to the infancy of the technology, and at Godalming the fact that the water wheel equipment was not uniquely designed for hydro-electric application, the installation also incorporated an auxiliary steam power installation for times of low flow or when the water-turbine was otherwise incapacitated (Haveron 1981).

[46] *The Electrician*, 1st October 1881
[47] In Haveron (1981). No source is cited.

Figure 4.2.2b Woodcut of Salgasson's Mill (also known as Westbrook Mill), c1800, anon.
Source: Surrey History Centre

The history of the hydro-electric installation at Godalming illustrates two particular aspects of the electric lighting industry at the end of the nineteenth century. Firstly, Godalming was an example of a scheme borne out of limitations with an existing gas contract which as outlined in 4.1 provided an opportunity for a superior form of public lighting and fostered a state of industrial competition between the two utilities. An article published in *Engineering* shortly after the opening of the station highlighted this particular state of affairs stating that the town was at "the forefront of the contest of the electric light *versus* gas"[48]. This decision to adopt the electric light over a continuation with gas lighting was seemingly based on both cost and provision. The local newspaper reported that the electric light would be 19 per cent cheaper coupled with a 125 per cent increase in illuminating candle power[49], superior public lighting provisions not to be refused. The intention was to offer the facility to the residents of the town for the illumination of their respective shops and houses. Anecdotal evidence suggests that this offer was taken up[50]. The gas company, in a bid to retain a competitive edge, had no choice but to offer lower prices to the Town Council for public lighting provision which it did until after the installation of the electric light and its contract with the Council was terminated.

Secondly, the example illustrates the way in which the first electric lighting demonstrations were considered experimental. Despite the commercial optimism for electric lighting, some in the industry reserved judgement being of the opinion that it was not yet sufficiently advanced to be considered a success as far as

[48] *Engineering*, 13 January 1882, 35
[49] *The Surry Advertiser*, 1 October 1881
[50] Eye witness account detailed in a letter from a Godalming resident to an unknown researcher, Surrey History Centre.

domestic lighting was concerned (see Grierson 1881). The experimental status of electric lighting was also evidenced by the comments of Joseph Chamberlain and Lyon Playfair, the politicians who, in the name of 'civic improvement', had earlier campaigned for legislation to facilitate the technological development and subsequent implementation of public electricity supply systems[51]. A full and detailed report in the trade journal *Engineering* demonstrated this was certainly the case at Godalming as it was decided by the local authority to "give the electric light of showing what it do"[52]. In addition to questions over the efficacy of electric lighting which was largely untested, engineers also acknowledged the application of water-power to the production of electricity as an experimental technology (see for example Baxter 1895). However, rather than hedging its bets, the majority amongst the engineering community both encouraged and pursued the further advancement of the novel technology which had the potential to increase accessibility to the new facility as a more ubiquitous natural resource than its coal and gas competitors (*ibid.*).

To some the fact that the technology was unproven was a cause for concern. For example at a meeting of the Board of Guardians of the Guildford Workhouse some were apprehensive about adopting unproven technology. Accordingly, caution prevailed with a vote of ten votes to six against adoption of electric light at the Workhouse (Haveron 1981). However, this could also have been a case of political allegiance to the gas company as local elites within late-Victorian civic governance often represented multiple civic interests (as will be demonstrated in

[51] see for example House of Commons Select Committee (1879)
[52] *Engineering*, 33, 13 January 1882, 35-6

chapter 5)[53]. Such an allegiance might also have been what caused one witness to report that the incandescent lamps (of which there were thirty placed in the outlying and bye streets) "were just as good as, and no better than, ordinary gas lamps"[54]. Alternatively envy might have been to blame, something to which the Mayor of Guildford was not ashamed to admit. According to Haveron (1981), at a dinner of the Ancient Order of Foresters the Mayor admitted that he was jealous "that a town like Godalming should have led the way with the electric light as Guildford was in a much better position to adopt it" (*ibid.*: 7)[55]. Electric light was evidently a coveted utility in late-Victorian civic arenas.

After a few technical hitches the system was successfully exhibited on 15th December 1881 to what was reportedly a grand audience, the appeal of the installation extending beyond the boundaries of the town itself. An article in *The Surrey Advertiser* reported that

> The lighting has so far been most satisfactory, eliciting the high praise of the hundreds of persons who have nightly congregated in the streets, including a good contingent from Guildford[56].

Intrigue over Godalming's electric light had ignited the interest of residents of neighbouring Guildford who had evidently abandoned any feelings of envy

[53] The gas company publicly fought back against the adoption of the electric light through an article originally published in the *Gas Journal* (Haveron 1981), reprinted in the *Surrey Advertiser* on 15th October 1881, which questioned the claims relating to the differences between the prices of gas and electricity as far as Godalming was concerned.
[54] *Newcastle Daily Chronicle*, n.d., in Haveron (1981)
[55] A local branch of a 'friendly society' first established in Leeds in 1834 which offered relief to the members who fell on hard times (see www.foresters.ws)
[56] 1st October 1881

previously demonstrated by their Mayor[57]. Aside from providing a local spectacle, the first demonstration of public electric street lighting clearly embodied a wider national significance. This is illustrated by the reporting of the opening in the national press[58]. Other interested parties (perhaps unsurprisingly) included Sir Joseph Swan who had collected cuttings from two local newspapers in his home town of Newcastle (Haveron 1981). The significance of both electric lighting through the activities of Swan himself, one of the region's notable residents, and hydro-engineering through the activities of Sir William Armstrong at Cragside, perhaps warranted a greater interest in Northumberland in the field than other regions hence its newspaper coverage of the opening of the installation. Aside from such details as the location of the three arc lamps (one near the Town Hall, several in King William Street and the others on the High Street and on Bridge Street, newspaper reports focused on the luminance of the light and the effect it created. For example, "All these lamps are successful in the highest degree. They give a constant, brilliant and far-reaching light, sufficiently subdued, however to be perfectly agreeable to the sight"[59]. Similarly, an article in *Engineering* reported:

> The seven arc lights, which, as we have remarked, are on one circuit, seem to be almost all that can be desired in the way of steadiness and brilliancy. The four arc lights which are disposed in the town light up the main street fairly, and the leading idea of the system of installation pursued, was to illuminate the main thoroughfare, and to supplement the arc lights by the Swan lamps for the dark corners and side alleys ... In the interior of the mill and in Mr Pullman's house the

[57] *The Surrey Advertiser* 1st October 1881
[58] See the *Daily Telegraph*, 30th September 1881; *The Graphic* 12th November 1881
[59] *Newcastle Daily Chronicle*, n.d., in Haveron (1981)

Swan lamps are seen at their best, and the light obtained leaves nothing to be desired[60].

The luminance of electric light was evidently considered superior to that of gas and reports praised for the new system. Perhaps the most interesting report of the demonstration however appeared in *The Graphic*; an illustrated British weekly newspaper which for its exploits in electric lighting described Godalming as a "spirited little Surrey community"[61]. The report observed:

> The effect of the quaint old High Street, with its gabled houses and miniature Town Hall, lit by the electric light is so strangely "theatrical," that one almost expects to see a bevy of fair damsels appear from the "sides" and dance across the street, while the "heavy villain" of the piece is attempting to conceal himself in the deep shadow at the back of the Town Hall. At present only three lamps are fixed upon poles twenty-four feet high. It is in contemplation to increase the lighting by about twenty smaller lamps. Although this will be an improvement practically, yet the picturesque contrast of light and shadow, now so striking will of course cease to exist[62].

The article unwittingly illustrated the ideas discussed earlier by Schivelbusch (1988) regarding the effect of lighting on the moral control of society, a kind of mythical rhetoric about light and dark, good and evil, that was similarly invoked in the local press:

[60] *Engineering* 33, 13 January 1882, 35-6
[61] *The Graphic*, November 12 1881, 483
[62] *Ibid.*

> Nature in all her varied moods will be called in to help us fight against the dark, and we shall be able eventually to turn night into day by the bright lamps which Nature herself kindles for us[63].

Although the article in *The Graphic* made no greater sizeable entry than any other on the page it was illustrated by two woodcuts. A simple line drawing that constituted the smaller of the two reflected the mechanical simplicity of the scheme. The second illustration however, reproduced here in figure 4.2.2c, occupied a half-page wood cut several pages overleaf, and became the most popularly reproduced image in connection with the installation and the development of electricity for public supply more widely in Britain (see for example The Electricity Council 1973a; 1973b)[64]. This particular portrayal of Godalming's electric light offers greater interest and the opportunity for reflection on how the scheme was perceived. The way particular buildings are presented as rustic, enlightened dwellings connect to the ideas of electrical apotheosis and 'enchantment' presented by Schivelbusch (1988). The central scene is illuminated by the light outside the Town Hall as well as the Town Hall itself representative of civic values which is purposefully presented in this way as central to the image. The illuminated main street is contrasted with the un-lit gloomy side streets, which, in conjunction with the accompanying textual description demonstrates the idea that the introduction of electric light affected the use of public space over time, i.e. night and day. Clearly a night time scene, several figures are depicted moving about with their carts to give the impression of an occupied street which might otherwise, like the side streets, have been largely deserted. The image

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[63] *The Surrey Advertiser* 1st October 1881

[64] The image was used as the jacket to The Electricity Council's 1981 centennial publication.

illustrates the ideas presented in the accompanying article of light and shadow, morality and deviance and in doing so again supports Schivelbusch's (1988) ideas this time regarding the moral control of public space through artificial lighting. Although gas lighting had up until now provided some artificial light during the hours of darkness, electric light with its greater luminance allowed the increasing use of public space after dark. This was a case of a technologically driven material change in the way people conducted their lives by affecting how and when people used certain public spaces (O'Dea 1958). The text and the image considered together present quite consciously the idea that light removed the protective shroud of natural darkness which enabled particular social deviance and through this a greater level of social and spatial control on behalf of the authorities.

Although the *electric* element of Godalming's public lighting supply was emphasised, despite the tribute paid to the town by the local press for it "being the first place where water has been adopted as the motive power for electrical purposes", very little significance was placed on the power source[65]. The report in *The Graphic* commented on the use of water as "a great peculiarity"[66], thereby reflecting the unprecedented use of water-power in this way. The only other mention of the motive power featured in the *Newcastle Daily Chronicle* making the point that "even last night, when the flooding was very bad, though not at its worst, 700 revolutions of the Dynamo machine per minute could be obtained from the water power alone, though 840 was required for its operation"[67]. As discussed earlier, the use of water to create electricity, although it soon became more

[65] *The Surrey Advertiser*, 1st October 1881
[66] *The Graphic*, November 12 1881, 483
[67] *Newcastle Daily Chronicle*, n.d., in Haveron (1981)

commonplace was largely incidental at this time. Although it was evidently considered extremely novel, this element of the system was largely ignored in favour of technological novelties and lighting effects of *electricity* rather than the employment of water-power.

Only a few short months into its operation, in December of 1881, local newspaper reports gloomily forecast an early end to the new lighting system, stating that "It is pretty generally accepted that the town will soon have to be partially, if not entirely, lit by gas again" (in Haveron 1981). The report was followed a week later with the news that the electric light would cease operating at the end of December "owing to its unsatisfactory arrangement" (*ibid*). The problem appeared to be a function of both inadequately developed water-power technology and geographical location: An article in *Siemens Magazine* noted that "when the river is swollen the drainage channel does not drain effectively enough to discharge the water which effectively creates a shorter fall of water between the two channels thereby reducing the water power available" (in Haveron 1981: 23). This subsequently reduced the illuminating power of the street lamps, a complication caused by the distance between the turbines and the area of supply. There were obviously concerns about this as an unreferenced report in Haveron (1981) stated "the physical or geographical arrangements could not meet the demands of the system ... The main reason for this lack of success with the Swan lamps is the distance of the source of electricity from the town and the comparatively small diameter of the cable". A report published in *Engineering* stated that had the station been located in a central rather than peripheral location the system would have been more successful. The article stated that

THE TOWN OF GODALMING ILLUMINATED BY THE ELECTRIC LIGHT

Figure 4.2.2c Woodcut of 'the town of Godalming illuminated by the electric light'
Source: *The Graphic*, November 12 1881

> It is a shame that the system has not been carried out in a way which would ensure success. With a central station instead of an out-of-the-way place chosen, it would have been easy to arrange the system, in this small town, as to be thoroughly efficacious and at the same time economical. As it is we believe the town has resolved to the old system of gas-lighting, or rather, we should say, to a new and very much improved system of gas-lighting, which will give the towns-folk twice as much light as they had before[68].

Evidently, as far as the some in the engineering community were concerned rather than the technology, it was the geography of the system which was to blame for its failure, which as illustrated above, for some warranted the reinstatement of the gas supply. However, in full support of water-power the engineering community were reluctant to concede its effectiveness as a new energy technology. The report concluded that

> With respect to the utilisation of water power for the lighting towns, the failure of Messrs. Pullman's wheels to meet the requirements of the case in this locality proves nothing[69].

Although the main public lighting provision was to revert to gas, the premises of Messrs Pullman and Charterhouse schools would retain the electric light. The continuation of this supply therefore suggests that their proximity to the hydro-electric generator determined a greater feasibility in terms of successful hydro-electric generation (see figure 4.2.2a).

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68 *Engineering* 33, 13 January 1882, 35-6
69 *Ibid.*

Although the use of water-power where recognised was seen as technologically innovative, both Tucker (1976) and Haveron (1981) reflect that the Godalming installation was not sufficiently technologically adequate to cope with demand, a point that was later raised by the Council in its discussion regarding the continuation of the provision[70]. Despite the reported failure of the scheme, electric light from water-power was extended and the supply was taken over from Calder and Barrett by Siemens after negotiations during the spring of 1882 between the Town Council and various suppliers over one-year contracts (Tucker 1976; Haveron 1981)[71].

The supply continued to operate successfully[72] until two years later when after lengthy negotiations between the Town Council, several electric lighting competitors, the Gas Company and Alexander Siemens, on 1st May 1884, despite the Council's preference for electric lighting over gas, Godalming reverted to gas lighting[73]. It would seem that the technology was not yet adequate to make the scheme economically viable: At a meeting with the Town Council, Alexander

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[70] See Minutes of Godalming Town Council, 13th December 1883; 27th March 1884

[71] The Council had had undertaken the installation prior to the Electricity Act 1882 being passed therefore operated without a Provisional Order. Given the ruling granting priority to Local Authorities, several letters requesting permission to apply for a licence were received in the autumn of 1882. Notifications were received from the Brush Company, the Swan United Company and the Gulcher Company of their intentions to apply for Provisional Orders as a result of the Act (Minutes of Godalming Town Council 9th November 1882).

[72] An archived correspondence from a local resident and an unnamed researcher dated 12th July 1954 stated that during the operation of the hydro-electric station floods "in some way upset the water power and so the dynamos were taken to a large shed at the back of the old White Hart" (7340/2/1-2, Surrey History Centre). However no mention of this is made in the Council Minutes.

[73] At a special meeting of the Council to discuss the future lighting of the town Correspondence was cited from the Edison Electric Light Company, the South Eastern Brush Company, the Hammond Electric Lighting Company and the Gulcher Electric Lighting Company, each of which had offered to tender for the contract, but none had offered satisfactory terms. In reference to the extension of electric lighting it was recorded that "the [Lighting] Committee are of the opinion that if compatible with the interests of the Corporation an effort should be made to retain the Electric Light and they are further of opinion [sic] that if so retained the Arc lamps should be discontinued and the incandescent Lamps increased in power" (Minutes of Godalming Town Council, 20th March 1884). Despite earlier difficulties with the failure of some of the arc lamps, the Committee were satisfied that these were technological details that could be overcome (see Minutes of Godalming Town Council, 2nd December 1882).

Siemens explained that his company was losing money through the Godalming system and unless the Council was prepared to consider a long-term agreement which would make it worthwhile investing in an expansion and re-equipment program Siemens would have to terminate operation of the scheme[74]. Furthermore, in an effort to restore its contract, the Gas Company had offered to increase its provision on a reduced rate. In addition to the flexibility of its terms the Gas Company also drew on the unreliability of water-power in support of a reinstatement of gas. In tendering for the lighting of the town the Gas Company stated

> that in making a Contract with us, you have the advantage of a Contract from Year to Year that may be terminated quickly, whereas you may have much anxiety and very much trouble, if you tie yourself up for five years to a Light which at best is but an uncertainty and as the mayor according to the Newspaper has not been up to the mark lately and the experience of the past will very likely be the experience of the future. In conclusion, we believe, our Lighting, not being dependent upon the number of revolutions made by an engine in one Minute, will be found more regular and on the long run much better than at present be supplied by electricity[75].

In its emphasis of the unreliability of the alternative power source, the Gas Company was certainly tenacious in its bid to re-establish its lighting provision such was the degree of commercial rivalry between the competing utilities. Reluctant to return to gas lighting, the town was canvassed for the prospect of further business by Siemens but the results were unsatisfactory. Despite the

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[74] Minutes of Godalming Town Council, 20th March 1884
[75] *Ibid.*, 27th March 1884

Council's preference for water-power in addition to widening engineering support for the technology[76], the contract with Siemens was terminated.

According to Tucker (1976) after several years of prevaricating over whether to undertake a second electric lighting scheme[77] the Council abandoned the notion and transferred the Provisional Order they had obtained in 1896 to a private company in 1899. The new works were opened in 1901 after a gap of seventeen years. Water power was *not* used. By 1903 three steam generating sets had been installed two at 90Kw and one at 200Kw generating capacity. Despite their good service, by 1928 the three generators were considered obsolete and replaced by a 200Kw diesel generator which continued to operate until the works closed in January 1950[78].

Westbrook Mill, the site of the original installation was damaged by fire on 9th December 1914 (Tucker 1976). Although it was repaired it was demolished sometime after 1952 (*ibid.*). Accordingly, the installation has been largely forgotten apart from by historians of the electricity industry who celebrate Godalming for its historical significance rather than its size or contribution to operating networks (see Southern Beam 1950; The Electricity Council 1973a; 1973b). As the article in the British Electricity Authority's journal *Southern Beam* concludes, on the closing of the replacement station in 1950, "although in the march of progress Godalming is giving way to her bigger brothers, the unique and

[76] See for example Grierson (1881); 'Hydro-Electricity', *The Electrician*, 25 March 1882, 300; '1881', *The Electrician*, 7 January 1882, 120-123; '1881', *The Electrician*, 14 January 1882, 136-139; '1881', *The Electrician*, 21 January 1882, 152-155
[77] See for example *The Electrician*, 25th October 1890; 12th February 1897
[78] The Godalming station was replaced by a larger station at Poole with a much greater operating capacity. It is implied by the *Southern Beam* (1950) that Godalming was inefficient, hence the decision to close it.

proud position which she had created for herself in the electricity supply industry can never be filled again" (Southern Beam 1950). Despite its relatively short life, the significance of Godalming's hydro-electric scheme as Britain's first electricity station for public supply placed the otherwise little known Godalming on the industrial and historical map.

4.2.3 Greenock, March 1885

Despite its topographical and climatological suitability to hydro-electric generation, only two stations opened in Scotland prior to the turn of the century. The first was at Greenock in 1884, making it the first settlement in Scotland to obtain a license to develop public electricity supply. An experimental installation in the first instance[79], the scheme evolved after the Police Board, which held responsibility for public lighting, lobbied for a Bill for lighting the town by electricity for which tenders were subsequently invited[80]. The Board was possibly prompted by the activities of the Greenock Harbour Trustees who in 1882 had invited tenders for lighting a portion of the harbour, quays and shed[81].

Despite the fact that the scheme did not come to fruition until 1885, an Electric Lighting Committee had been appointed two years earlier in February of 1883. It first reported to the Law and Finance Committee in the following April delineating a 38¼ acre area to be supplied with electricity to be generated by the

[79] According to a report in *Engineering*, only a section of the town was to be lit "with a view of gaining practical experience" (20th March 1885, 295).
[80] *The Electrician*, 7, 29th October 1881, 369
[81] Law and Finance Committee Minutes 1882, Greenock Harbour Trust, Glasgow City Archives

water power available at the premises of the Water Trust on Prospect Hill[82]. It was reported in *Engineering* that "the high hills at the back of Greenock give a good supply of water for power, and this has been utilised for the purpose"[83]. The proximal location of a water source to an area proposed to be artificially lighted was a factor that had the potential to influence such decisions. The engineers used water-power in this instance for the simple reason that *it was there*. However this was a decision borne out of *economical* rather than *environmental* considerations. Later Committee minutes reveal that given the experimental nature of the scheme little sense could be found in further financial outlay for steam-power when water-power came virtually free of charge[84]. The cost of converting the premises of the Water Trust for water-powered electricity generation was less than £250, a quarter of the estimated total. However, the utilisation of the local water supply was not without its limitations: Consultation between the Police Board and Alexander Siemens concluded that to extend the area of supply would seriously hinder the efficiency of the scheme as power would be absorbed in the transmission of electricity[85]. Like Godalming, for the employment of water-power to be efficacious at this point in time, the location of the generating station was crucial. Siemens was evidently drawing on his experience at Godalming: in its bid to facilitate hydro-electric development, the 1882 Act in this way was proving effective.

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[82] Law and Finance Committee minutes 24th April 1883, Greenock Police Board, Glasgow City Archives. Evidently a matter of keen public interest, this report was reproduced in full in the local press (See Greenock Telegraph 16th May 1883).
[83] *Engineering*, 20th March 1885, 295
[84] *Ibid.* 25th May 1883, Greenock Police Board, Glasgow City Archives
[85] *Ibid.*

Initial negotiations with the BoT seemed to hinge on the period of license[86]. Greenock Police Board sought a five year term, but the BoT was of the opinion that this would hinder the development and future introduction of electric light. However, placing emphasis on the commercial profitability of the scheme it agreed that if this could not be proven after the initial two years, an extension could be sought. The Electric Lighting Committee reported that it was better to accept this two year provisional period than run the risk of having to fight competition from the Electric Lighting Companies the following year. The prospect of "having the town taken possession of"[87] by Electric Lighting Companies, for the Committee, was a situation to be avoided: In a clear demonstration of municipal socialism, if there was profit to be made from the new industry it should be kept within Greenock for the benefit of local ratepayers.

Seven tenders were subsequently received, including proposals from R.E.B. Crompton and the Brush Company[88]. It is noted without explanation that despite earlier consultation Siemens declined to tender. Due to a novel form of bitumen-coated cabling (Tucker 1976) the Committee opted for Brush's tender and a system of twenty public lamps was duly implemented. In August 1885 arrangements were made to extend the supply to the Roxborough Street Sugar Refining Company, located within the designated area of supply, for a period of three years[89].

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[86] *Ibid.*
[87] *Ibid.*
[88] *Ibid.* 17th July 1884.
[89] Electric Lighting Committee minutes 10th September 1885, Greenock Police Board, Glasgow City Archives.

The system operated satisfactorily[90]. However the 1886 year-end accounts showed a deficit of £150[91]. Without explanation on 7th April 1887 it was agreed that the contract with the refinery should be terminated. It was also reported that the machinery and works at Prospect Hill were in good order. Despite the reported success of the installation it was terminated in 1887 like Godalming, after two years operation. Little information regarding the closure of the scheme is found save a report in the *Electrical Review* for 24 June 1887 that stated that the closure was solely due to the heavy charges for lamp renewals. The extent to which this early experience of using water power contributed to the decision to employ steam over water when electric lighting returned to the town in 1900 is therefore indeterminable.

Although the undertaking was short-lived, Greenock holds its place as one of the first towns in Britain, and certainly *the* first in Scotland, to employ water-power for the generation of public electricity supply. Despite this historical significance, in a report on the system which appeared shortly after its initial operation, emphasis is instead placed on the novel underground cable that was used which captured the interest of the engineering community[92]. Once again, a factor which from a historical perspective might seem significant is overlooked in favour of other technological innovations, thereby reinforcing the point that, as illustrated with the examples of Cragside and Godalming, the use of water power at this point was incidental, and certainly secondary to other developments in the field of electrical engineering. It was perhaps the case that the use of water to power electricity generation was just one of many technological advances in the field of

[90] *Ibid.* 11th May 1886
[91] *Ibid.* 10th September 1886
[92] See *Engineering*, 17 July 1885, 49-51.

Victorian electricity supply engineering, where ideas of novelty and technological innovation dominated more mundane issues such as the source of motive power.

4.2.4 Blockley, early 1880s

Contemporaneously to Greenock a further hydro-electric scheme was being implemented south of the border, although this was of quite a different nature to Scotland's first installation. Although Tucker (1976) did not pursue it he found evidence for a further installation in the village of Blockley in Gloucestershire, citing a local history publication by H.E.M Icely (1974)[93]. Consultation of Icely (1974), which includes a chapter on the history of the scheme by A.W. Exell (1974), suggests the installation was significant.

In a local history publication Icely (1974) refers to a hydro-electricity scheme that became operational in the Gloucestershire village in the late nineteenth century. The author dates the installation at 1888. However, evidence collected by Exell (1974) suggests it was implemented earlier, between 1880 and 1885[94], which would position the scheme amongst the earliest hydro-electricity installations in the country. The scheme was powered by a water wheel housed at Dovedale House, a private residence in the village (see figure 4.2.4a). It was installed primarily to supply electricity to the dwelling, but it also supplied the village

[93] Tucker does not explain why he chose not to research Blockley further.

[94] According to an unreferenced article which appeared in *Midlands Electricity* in August 1961, the son of the founder of the installation, Captain E.G. Spencer-Churchill remembers that installation took place prior to the family leaving Blockley in 1887, and puts the date more precisely between 1884 and 1885. See also footnote 101.

church, two of the village shops and several other private houses in Blockley (Exell 1974)[95].

Icely (1974) deduced that the project was instigated by Lord Edward Spencer-Churchill, proprietor of Dovedale House and a younger son of the Duke of Marlborough. This was based on three pieces of evidence: Firstly, three of the directors of the company which later took over the service provision (of which Spencer-Churchill was chairman) were relatives of his wife Augusta Warburton, the daughter of Lady Northwick and Major George Warburton. Secondly, the dynamo was installed in one of the mills in close proximity to his residence, Dovedale House. Thirdly, his brother, Lord Randolph Spencer had also utilised water power to generate electricity in his London property, which Exell (1974) suggests set the example for Spencer-Churchill himself.

Characteristic of late-nineteenth century hydro-electric development, the industrial heritage of the village served to facilitate the establishment of hydro-electricity generation. Blockley had traditionally depended on silk milling as its primary industry. However, a collapse of the trade in the 1850s left eight of Blockley's thirteen watermills silent and disused[96]. In its re-use of abandoned

[95] According to Exell (1974) several other churches in Britain claim to have been lit by electric light prior to this, although none by water power.
[96] The silk-throwing trade had begun in Blockley in late seventeenth century under the auspices of Henry Whatcott and had prospered into the nineteenth century reaching its zenith in 1824 when there were eight silk mills along the Blockley Brook and its Cole Brook tributary (Icely 1974). In 1825, however a sudden check was brought to the silk mills of Blockley when the prohibition of French silk imports was suspended. This meant that British producers were protected by no more than a thirty per cent import duty with the result that Blockley piece wages fell by twenty-five per cent from 16d. to 12d. for a pound of spun silk. By 1850 three of the eight mills operational in 1830 had closed. In 1859 this effect was compounded and the silk trade in Blockley effectively terminated when a commercial treaty between France and Britain allowed the trade of silk between the countries free of all duty. In August 1860 the Evesham Journal reported that "All the mills have been still the greater part of the summer" (in Icely 1974).

industrial sites, notably mills, Blockley was typical of late-nineteenth century hydro-electric generation[97].

The electricity supply to Blockley was undertaken in two stages. The first (under the proviso of Lord Spencer-Churchill) was housed in one of the disused mills, which given its proximity to Dovedale House (see figure 4.2.4a) was probably Dovedale Mill (depicted in figure 4.2.4b) although Exell (1974) states that it was Smith's Mill which housed the main installation. Additional mills, also disused, were brought back into motion to provide supplementary power, one of those being Webb's mill where a further dynamo was later added by one of the three Humphries brothers (Exell 1974)[98]. The second installation, known as the Astral Works, housed at Mill Close, a further disused mill in the centre of the village, appears to have been a more commercial undertaking by the Blockley Electric-light and Manufacturing Company (of which Lord Spencer-Churchill was chairman); a group of interconnected individuals who had later joined Spencer-Churchill to establish a formal electrical supply company in 1887[99]. Exell (1974) states that the company intended to

[97] For a map of the location of each mill see Icely (1974).
[98] Exell (1974) suggests they were local mill-workers.
[99] This is when the Company's Articles of Association are dated. Alexander William Hall was an MP; Both Charles Barter and Nigel Warburton were electrical engineers and their fathers, Henry Barter and William Warburton respectively, men of the cloth; Henry Montagu-Spencer is recorded as a 'gentleman' and was probably (given the surname) related to Edward Spencer-Churchill himself (Exell 1974).

Figure 4.2.4a Dovedale House c. late nineteenth century
Source: Corinium Museum, Cirencester

Figure 4.2.4b Dovedale Mill c.1954
Source: Corinium Museum, Cirencester

acquire a lease of a mill, at Blockley, in the county of Worcester, or elsewhere, with water or other power, and to acquire land, works, property and premises wherever convenient, machinery, patent rights and other property and to acquire and establish other businesses and property as may seem expedient[100].

This statement of intent suggests the company's commercial ambitions went beyond the specific production of electricity for Blockley. This second installation at the Astral Works and the establishment of the Company, according to Exell (1974), coincided with the economic depression in Blockley as a result of the collapsed silk trade upon which the local economy had once depended and which had reportedly brought 'grievous poverty' to the parish in the late-Victorian age (Icely 1974). The extent to which the electric light company was established specifically to address issues of local unemployment is indeterminable; however its stated intent to expand (or at least not to limit) its manufacturing interests suggests that this may have been a central aspect of the company's activities. Whether or not this was the case, Exell (1974) suggests that the establishment of the electrical supply company undoubtedly had a positive effect on the collective psyche of the Cotswolds village if not its collective pocket. This assumption is drawn from the verses of a local poet cited in Exell's (*ibid.*) account of Blockley's hydro-electric endeavours which makes reference to the light erected on the top of Blockley's church tower which reportedly produced a "moonlight glow" which could "be seen from four counties" (Exell 1974: 228)[101]. The poem laments the

[100] Articles of Association of the Blockley Electric-lighting and Manufacturing Company dated 12 December 1887 (Exell 1974).

[101] In 1888 a report entitled "church lighting" appeared in *The Electrical Engineer* (20th April 1888) announcing the hydro-electric supply to the parish church at Blockley. The report indicated that this was the beginning of the supply which perhaps explains why Icely (1974) dates the opening of the station during this year. However, evidence collected by Exell (1974) suggests it was started earlier. See footnote 94.

days gone "when Blockley with the world would cope", presumably as a result of the collapsed silk trade, but ends on a more triumphant and consolatory note:

> Our church is lit
> It is a wondrous sight
> For we can manufacture
> The electric light
>
> (in Exell 1974: 228)

The verse conveys two points of significance: Firstly the assembly of an electric light on the village's church tower connects to more general late-nineteenth century notions of the connection between light and deism and reinforces Schivelbusch's (1988) idea about "electrical apotheosis". Through its night time illumination The Church (as an institution rather than a venue) both physically and spiritually was positioned as an omnipresent beacon of light; a central and significant spiritual space to which the community of its hinterland could gather. Clearly conclusions about the importance of religion, specifically Christianity in the Victorian era can be drawn although it is beyond the scope of thesis to do so here. In doing so through the connection of electric lighting to the highest religious and *cultural* authority a sense of the importance of electric lighting during this time can also be deduced.

The verse also conveys the sense that the ability to generate electricity was symbolic of the village's return to economic prosperity. This is further illustrated by a shop advertisement reproduced in Exell (1974) which proudly stated that on and after 27th October his shop would be illuminated by Electricity! What at present will not be found in Worcester, Gloucester, Hereford, Oxford, Warwick or in many Cities or Towns in England and Wales[102].

The electric light in Blockley evidently became a commodity upon which its local businesses could trade, an important aspect given the recent economic depression of the locality. This example also illustrates the argument proposed earlier that electric light became a cultural symbol of Victorian aspirational living.

By 1901, responsibility for lighting the village had passed to J. Draper and C. Barter[103]. Whether the two individuals constituted the total group of company owners or whether they were just part of the collective is unknown. Exell (1974) states that dynamos were later (although the author does not state when) added at both Snugborough Mill and Mill Dene other abandoned silk mills in Blockley. It would seem that hydro-electric power had replaced silk as the main product upon which the local economy came to depend. In 1931 the hydro-electricity works at Blockley was taken over and modernised by the SWS Power Company and was connected to the National Grid after the Second World War (Icely 1974).

As stated earlier, some hydro-electric schemes demonstrated greater significance than others. The following two schemes, the first at Wickwar in Gloucestershire and the second at Okehampton in Devon, were both subsidiary schemes of private

[102] Advertisement for J. Joyner, Grocery, Wine and Spirit Provision Establishment in Exell (1974: 228). Unfortunately the advert does not mention the year, neither is Exell (1974) able to infer it although it must have been before 1894 when Worcester established its electricity provision.
[103] Blockley Cricket Club records (in Exell 1974).

installations; the public supply being secondary to their main purpose of lighting private premises. Despite their origins as secondary interests, as a means of illustrating the diversity of public hydro-electric supply in the late-nineteenth century, they are included here.

4.2.5 Wickwar, October 1888

The scheme at Wickwar was a small installation at the brewery of Messrs Arnold and Perret which sold the surplus supply to the town for street lighting. On 5th October it was reported that "on the 2nd inst. the town of Wickwar, near Stroud, was lighted by electricity by a somewhat novel arrangement"[104], presumably in reference to the use of water-power. Fifteen lights were erected in the streets, the furthest three-quarters of a mile from the brewery[105]. After three years the provision had been extended to twenty incandescent lights, at a cost of £15 a year[106]. Typical of the Victorian spirit, the thrift upon which the installation had been undertaken was worthy of comment in the trade press, the journal remarking that "everything connected with it has been done as cheaply as possible, consistently with efficiency ... the whole installation is regarded a complete success"[107]. The term of the installation is indeterminate but the previously cited report stated that the installation was then in its fourth season "for like most country places, the public lamps are only lit during the winter" thereby suggesting

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104 *The Electrical Engineer*, 5th October 1888
105 *Ibid.*
106 *The Electrical Engineer*, 27th November 1891
107 *Ibid.*

a comparably lengthy scheme to its previous counterparts at Godalming and Greenock[108].

4.2.6 Okehampton, January 1889[109]

The public electricity supply at Okehampton was derived from the surplus supply to a local sawmill owned and operated by Henry Geen a local builder and timber merchant (Harris 1968; Tucker 1976). Taking water from the East Okement River, Geen had recently installed a turbine to drive the machinery and light the mill with a capacity of around 8Kw. Geen's hydro-electric development was evidently an extension of his local philanthropy: Geen had also built a chapel in Chagford to which the supply was later extended as well as nearby houses and other buildings[110].

In 1896 the water-power was supplemented with steam, and later gas. Unlike its predecessors (with the exception of Blockley) Geen's scheme operated with some longevity continuing to operate until 1930 when it was taken over by the West Devon Electricity Supply Company. It was eventually dismantled when the new Mary Tavy hydro-electric station was opened in 1937 on the same site, which was

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[108] *Ibid.*

[109] Despite published records dating this installation at 1889, evidence would suggest that an electric lighting supply by Geen was made earlier in 1885 (see *The Electrician*, 21st December 1885; 8th March 1889; *Kelly's Directory* 1893). In 1889 it was reported that "The directors of the Okehampton Gas Company have decided to apply to the town council for the purpose of supplying the electric light. The directors have thought this step advisable in consequence of the successful installation of the electric light in the town by a local firm (Messrs. Geen and Co.)". This report not only suggests an earlier date for the installation, it also demonstrates the threat posed by electric light for local gas suppliers who in this case proposed diversification as a means of maintaining commercial viability, although it must be noted that this was an unusual course of action for the gas industry (*The Electrician*, 8th March 1889). Gas was evidently considered expensive according to an report which remarked "since gas costs 5s.10d in Okehampton the economic conditions are evidently favourable" (*The Electrician*, 21st December 1885). See also footnote 122.

[110] *The Electrical Engineer*, 23rd August 1889

then Britain's largest hydro-electric station for public supply, with an installed capacity of 2.6Mw[111]. No visible remains of this early electrical venture remain (Harris 1968).

The installation at Okehampton was followed by two further stations in Devon, similarly both as a result of private enterprise: The electric lighting industry whether powered by water or steam was an embryonic industry in which individuals had the opportunity to profit (despite an emphasis on municipal trading). The first of these was opened at Lynmouth[112] in 1890, the second at Chagford a year later. However, prior to considering these installations further, a more general note on Devonshire hydro-electric development is pertinent. By the early 1890s, hydro-electricity had established itself as a viable industry in the county of Devon which, unrivalled by any other region in the country, by the early years of the decade boasted three installations; a reflection of the importance of the connections between water, landscape and energy within the county. In a contribution to a county series on Industrial Archaeology, Helen Harris (1968) stated that this, in addition to more historical traditions of water-power in the region was owing to the upland topography of Dartmoor. On the historical connections between Dartmoor's natural resources and water-power, Harris wrote:

> Water being until modern times a most important source of power, it is only to be expected that, so well blessed with tumbling streams, mills should have been set up not only to supply the basic necessities of life but also to serve the purposes of

[111] See Garcke, E., 1922-3, *Manual of Electrical Undertakings*, vol. 26
[112] The scheme also supplied Lynton, perched on the cliff above Lynmouth.

> thriving trades. It is often hard to realise, in the highly powered mechanical world of today, what a very real asset the abundant water of Dartmoor was as a source of energy. This abundance, coupled with the velocity it gathered in its fall from the moorland heights, once harnessed by man's ingenuity to turn one or a succession of wheels, provided that power was both cheap and reliable (Harris 1968: 138).

Not wanting to ignore this rather romantic interpretation of Dartmoor and its intimate connection to the region's industry, Harris' final words here perhaps provide more insight into contemporary perceptions of water as a resource. As demonstrated in the case of Greenock, free-flowing water was seen as a convenient and cheap power source, superior in this respect to the cost and inconvenience of steam. Victorian engineers were nothing if not resourceful, albeit motivated by profit over environmental considerations.

4.2.7 Lynmouth, March 1890

The town of Lynmouth lies at the mouth of the East and West Lyn Rivers which converge at the centre of the small town and empty into the Bristol Channel (see figure 4.2.7a). Both rivers cut deep gorges down the river valleys as they made their steep descent from the moors above thereby affording them powerful heads of water. An entry for Lynmouth in the 1893 *Kelly's Directory* described the locale thus:

> So called from its situation at the confluence and mouth of the East and West Lyn, on the outskirts of Exmoor, [Lynmouth] is well known as a popular and beautiful watering- place, occupying a level site, near the seashore, at the entrance of an

> immense gorge, into which the magnificent ravine of the East Lyn and the densely wooded but sequestered valley of the West Lyn abruptly descend, the twin streams after heavy or long continued rains, assuming formidable proportions, and rush down to the sea with extraordinary speed and great uproar, with the circuit of a few miles inland there is every variety of hill and dale, with woody tracts and moorland of vast extents and valleys of extreme beauty traversed, traversed by mountain streams dashing, impetuously over their rock strewn beds.

As previously considered, the suitability of the Devon landscape to the employment of water-power as argued by Harris (1968) was perhaps nowhere more evident than at this quaint coastal resort. The development of a hydro-electric station at Lynmouth thereby illustrates once again the intimate connections between water, landscape and energy.

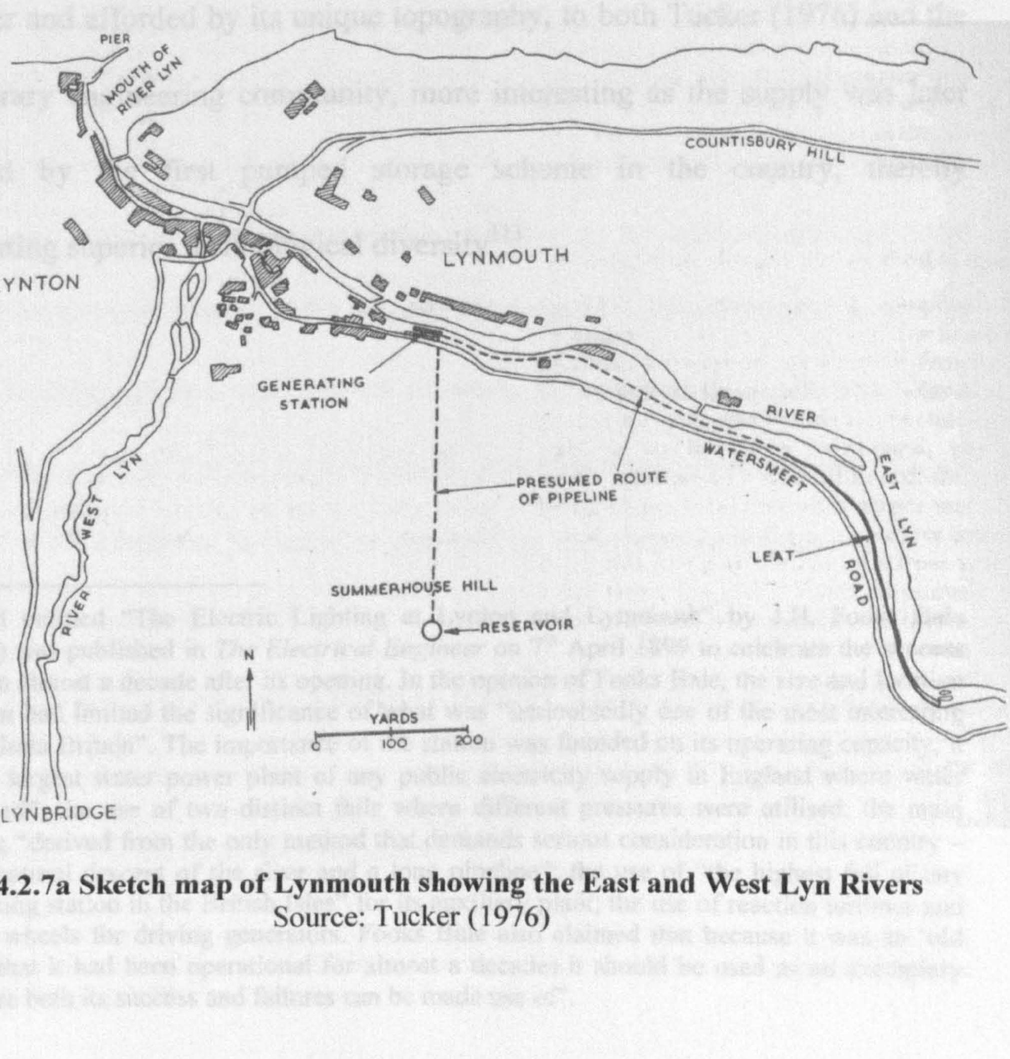

Figure 4.2.7a Sketch map of Lynmouth showing the East and West Lyn Rivers
Source: Tucker (1976)

The scheme at Lynmouth shared two characteristics with its West Devon counterpart. Firstly, like Okehampton, the scheme at Lynmouth was the private enterprise of a local philanthropist and entrepreneur. The businessman in question was Charles Geen who happened to be the brother of Henry Geen, proprietor of the station at Okehampton. In a furtherance of his entrepreneurship Charles Geen later established the Devon Electric Light Company in 1889 (see figure 4.2.7b). The company later widened its electrical supply activities and became the West Devon Electric Light Company which in 1930 took over the Chagford hydro-electric station. It takes no great leap of the imagination to propose that in his hydro-electric activities given the family relationship and geographical proximity Charles had followed the example set by Henry before him at Chagford. However, the similarities end there. The Lynmouth hydro-electric station was both larger and afforded by its unique topography, to both Tucker (1976) and the contemporary engineering community, more interesting as the supply was later augmented by the first pumped storage scheme in the country, thereby demonstrating superior technological diversity[113].

[113] A report entitled "The Electric Lighting at Lynton and Lynmouth" by J.H. Fooks Bale (A.M.I.E.E.) was published in *The Electrical Engineer* on 7th April 1899 to celebrate the success of the station almost a decade after its opening. In the opinion of Fooks Bale, the size and location of the station had limited the significance of what was "undoubtedly one of the most interesting stations in Greta Britain". The importance of the station was founded on its operating capacity, it having "the largest water power plant of any public electricity supply in England where water power is used"; the use of two distinct falls where different pressures were utilised; the main supply being "derived from the only method that demands serious consideration in this country – that is, the natural descent of the river and a long pipeline"; the use of "the highest fall of any electric lighting station in the British Isles" for its auxiliary plant; the use of reaction turbines and pressure jet wheels for driving generators. Fooks Bale also claimed that because it was an 'old station' (in that it had been operational for almost a decade) it should be used as an exemplary model "where both its success and failures can be made use of".

Figure 4.2.7b Premises of the Devon Electric Light Company in Okehampton, n.d.
Source: South Western Electricity Historical Society

The generating station which consisted of a substantial stone building with engineer's residence was situated on the bank of the East Lyn depicted here in figure 4.2.7c What is notable about the building is its architectural harmony within its local environment. The station is virtually undetectable as a site of industry; undifferentiated and nestled between its residential neighbours. This particular aspect of Victorian hydro-electric generation was common and unique to this era of development, a factor determined by their relatively small operating capacities compared to their later twentieth century counterparts which, corresponding to the Modernist sensibility became larger, more conspicuous and as explored in chapter 2, some have argued incongruous in their surrounding otherwise rural, unindustrialised landscapes[114].

[114] For a further discussion of preservationist discourses see for example Luckin (1990); Matless (1990; 1998); Wright (1995).

Figure 4.2.7b The hydro-electric generating station at Lynmouth, n.d.
Source: South Western Electricity Historical Society

A full technical description of the scheme appeared in the local press in April 1890[115]. As well as the streets, several public buildings, hotels and private houses were to be supplied with electric light by means of water power derived from the East Lyn[116]. Not only did the electric light provide a new facility for the residents of the town, it also served as a local amenity which could be promoted to attract visitors and tourists. Invoking ideas of its natural geographical position, the following entry appeared in the local press shortly before the electricity supply became available:

[115] See *North Devon Journal*, 17th April 1890
[116] *Ibid.*, 8th August 1889; 17th April 1890

> Lynton leads the way in availing itself of the advantages of modern invention. The "English Switzerland" will be the first town in Devon lit with the electric light. The natural facilities which the locality offers for the employment of the brilliant illumination have led to an arrangement by which "the local board will replace the light of other days" with its modern rival on most favourable terms ... Lynton has a substantial solace in the new Promenade, the lift fast being completed, and the electric lighting of the main road between Lynmouth and the upper town which will soon be an accomplished fact. Nature has richly endowed this charming locality, and the judicious enterprise of its inhabitants yearly increases its attractions for the visitor[117].

From this promotional piece of journalism two observations can be made. Firstly, the connection of the hydro-electric installation to other civic 'enhancements' demonstrates how the scheme contributed to a wider program of improvement in the town, which given the emphasis in the above article on visitor attraction was being implemented to boost tourism[118]. As witnessed in the case of Godalming, electric lighting demonstrations were something of a spectacle, drawing visitors to witness the new invention in a manner akin to religious awe (Schivelbusch 1988). What is also conveyed is an awareness of the intimate connections between Lynmouth's natural resources and local amenity. As cited in the article, Lynton also boasted a hydraulically powered cliff railway linking the cliff-top town with its harbour-side neighbour[119]. Water-power was therefore intimately connected to the civic improvement of the resort.

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[117] *North Devon Journal*, 8th August 1889

[118] A report in *The Electrical Engineer* of 12th February 1892 records a request by "most of the residents at Lynmouth asking for a 2000-c.p. arc light to be placed on the Tower for the benefit of the fishermen and the lighting of the Esplanade and lower part of Lynmouth".

[119] Funded by local philanthropist the lift was opened in 1896 and with few alterations continues to ferry passengers between Lynton and Lynmouth.

In 1894 the installation was augmented by a pumped storage scheme, according to Tucker (1976) to meet the ever-increasing demand on supply, but evidence also suggests this may have been to secure the water supply as the scheme was blighted by low river flows and according to a later report, the owner of a flour mill upstream persistently interrupted the water supply when demand was heaviest[120]. During periods of low demand water was pumped to a reservoir at Summer House Hill 800ft above Lynmouth and fed back at periods of peak demand (the reservoir is depicted in figure 4.2.7d).

Despite this augmentation, the plant continued to experience low flows. An entry in *The Electrical Engineer* of 27th February 1890 reported that "The electric light which has been entirely absent from Lynton and Lynmouth since Christmas, reappeared at Lynmouth last week, and has been satisfactory there, but has failed to reach Lynton. An engineer has recently tested the wires, and reports that the joints are in a very defective state. The matter is being attended to with all speed". Low flows were also referenced in Fooks Bale's (1899) review of the installation which reported that "In 1899 the oldest inhabitant could not remember the river at a lower level than which would give anything up to 200h.p. But since 1892 the river has, from no apparent cause, been getting beautifully less every year, until 1898, at the end of August not more than 20h.p. was available". However, flooding also obstructed the supply, a report in *The Electrical Engineer* of 29th September 1893 recording "an unpredictable supply during winter months of flood". Records reveal that two more-efficient turbines were installed in 1904 and 1911, both of which were replaced by oil engines in 1921 (Tucker 1976). Despite

[120] 'A pioneer pumped-storage scheme', *Water Power*, 7, 1955, 76

Nature's endowment, low river flows continued to blight the scheme. Somewhat ironically, in August 1952 the plant, including the pumped storage scheme, was destroyed by a flash flood, which caused considerable loss of life and destruction of property. By that time however, electricity supply to Lynton and Lynmouth was already in the process of being transferred to the National Grid, so the operation of the station was already limited. The hydro-electric station was not rebuilt and all remains of both plant and reservoir have virtually disappeared. A working demonstration of hydro-electricity now sits on virtually the same spot as the old station and serves as a memorial to both the industrial history of the town and the events of August 1952.

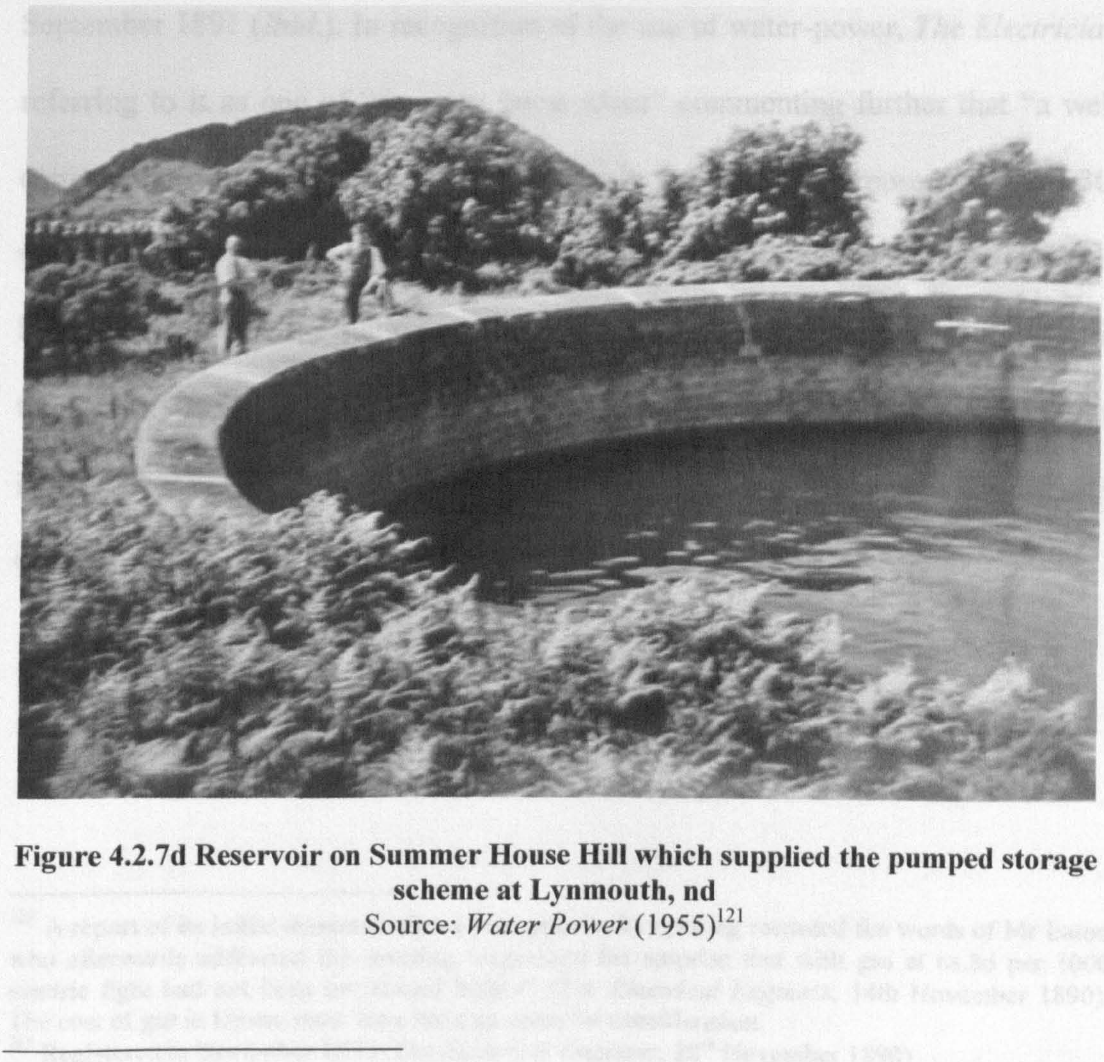

Figure 4.2.7d Reservoir on Summer House Hill which supplied the pumped storage scheme at Lynmouth, nd

Source: *Water Power* (1955)[121]

[121] See footnote 120

4.2.8 Chagford, September 1891

The third Devonshire scheme was at Chagford, ten miles south-west of Okehampton. Lit by gas since 1869 (*Kelly's Directory* 1893), the electric lighting provision began in 1890[122]. Powered by the River Teign, the station was a small system with an installed capacity of 20Kw operated by the Chagford and Devon Electric Light Company[123]. The plant was housed in a woollen mill leased by G.H. Reed, a local millwright and machinist and director of the Company. The mill workings had undergone various periods of disuse and when Reed took them over in 1890 they had lain derelict for 10 years (Harris 1968). A waterwheel at his mill was converted to work the lighting plant, first illuminating the town on 1 September 1891 (*Ibid.*). In recognition of the use of water-power, *The Electrician* referring to it as one of "the very latest ideas" commenting further that "a well constructed water-wheel runs perfectly steady for lighting purposes"[124]. In 1930, the Company became part of the West Devon Electricity Supply Company which had also taken over the station at Okehampton during the same year. Although, in the early 1970s Tucker (1976) found that the plant was still in operation with an installed capacity of 26Kw and connected to the Grid under the Central Electricity Generating Board, it has since closed.

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[122] A report of its initial demonstration a year prior to its opening recorded the words of Mr Eaton who afterwards addressed the meeting "expressed his surprise that with gas at 6s.8d per 1000 electric light had not been introduced before" (*The Electrical Engineer*, 14th November 1890). The cost of gas in Devon must have been an issue for consideration.

[123] Registered in November 1890 (*The Electrical Engineer*, 28th November 1890)

[124] 4th September 1891.

4.2.9 Keswick, January 1890

From the relatively low-lying uplands of southern England to its more mountainous northern counterparts, Keswick hydro-electric station was located in the heart of the Lake District, a landscape bestowed with the natural resources ideal for hydro-electric generation. This was clearly a significant scheme as twenty-seven short pieces on the station were published in the trade press between 1889 and 1898[125]. An account of the Keswick system written by engineers of the scheme William Fawcus and Edward Cowan proudly described it as "the first attempt to utilize available water-power in this country for the purposes of a public supply of electric light" which perhaps explains in part the level of interest despite the construction of several stations before it (Fawcus and Cowan 1890: 154). As much as the engineers would have coveted this accolade, this was evidently an error due to construction and subsequent operation of seven stations prior to Keswick.

Supported by "several of the most influential residents"[126] and described as the first *substantial* hydro-electric station in Britain by Tucker (1976), the Keswick hydro-electric station opened in 1890. The station was initially operated by the Keswick Electric Light Company which made use of the existing civil engineering works of an old woollen mill housed on the River Greta from which it derived its motive power[127]. The example of the Keswick hydro-electric station, as the subject of a report by its own engineers, affords some insight into the

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[125] See for example *The Electrical Engineer*, 3rd January 1890; 10th January 1890; 17th January 1890; 11th December 1890; 2nd March 1894; *The Electrician*, 24th October 1890

[126] From an unspecified report in the *Electrical Engineer* in Tucker (1976)

[127] Some modifications were made to maximise the water power: the tail race was lengthened from 70 to 100 yards and deepened by 4ft and head race improved to 7ft width and 3ft depth

considerations of the engineers who developed such systems during this era, specifically the way in which the Victorian engineer imagined Nature in relation to the production of energy. The purpose of Fawcus and Cowan's paper in their own words was to explain their "method of converting to a useful purpose a natural supply of energy now generally allowed to run to waste" (Fawcus and Cowan 1890: 154). This quote illustrates so rudimentarily the way in which natural resources specifically the power of water was seen as being wasted, a vision of water which continued into the twentieth century[128]. The sense that a resource might be being squandered in this way directly connected to Victorian visions of the environment which were characterised by ideas of efficiency on both a practical and aesthetic level. Unlike late-twentieth century environmental concerns, the perceived 'wastage' of water was not influenced by ideas of resource depletion, but rather notions of economic efficiency. The primary benefit of employing water as the civil engineers of the Keswick scheme saw it was the reduction in cost: "At a time when coal is dear ... it is expedient to make use of all natural sources of power which may be found suitable" (*ibid*). In the discussion, acknowledging the economic and logistical advantages of water-power, Mr Mordey[129] commented that for these reasons the use of water-power for the generation of electricity was "sure to come to the front" (Fawcus and Cohen 1890: 169). The sentiments expressed in Fawcus and Cowan (1890) support observations made in chapter 3 that the use of water for the production of energy in the late-Victorian era was a demonstration of cost-efficiency achieved

[128] See for example Mackinder (1902); Williams-Ellis and Williams Ellis (1951).
[129] The published account of the installation included the post-presentation discussion. As Mordey later referred to the Lynmouth system directly, this was possibly the same engineer responsible for the development of the Mordey-Victoria system; an alternating system employed at both Lynmouth (see *North Devon Journal*, 17th April 1890) and Bath (see Eyles, E.W., 'Electricity in Bath 1890-1974', *Histelec News* 31, December 2005).

through the negation of the use of coal. Where an alternative source of power was available, whatever that may be, it made economic sense to utilise it. Water was simply a non-specific alternative.

By 1891 the directors of the company were complaining that the demand for light exceeded supply, warranting further provision of power. Due to difficulty with raising capital this was not achieved until 1894, at which point the Company had "confident expectations of being able very soon to use the whole water-power of the river, without which success is impossible" (unspecified source in Tucker 1976: 138). The installation was consequently augmented with steam-power. Despite claims that this was because funds could not be raised to modify the hydro-electric scheme "the possibility of partial failure of the water-supply during extreme drought in summer" was also a factor in the decision to include steam-power (Fawcus and Cowan 1890: 155). The experience of previous schemes had evidently provided the engineers with a greater understanding of the limitations of water-powered electricity supply systems that only practical experimentation at for example Godalming and Greenock could expose. In this respect, again the 1882 Act developed specifically for the practical experimentation of electric lighting technology had achieved its goal.

For unexplained reasons, for the first eight years the installation had operated without a license (which authorised operators to dig up the streets for laying cables) and had therefore used overhead cables. Complaints over the unsightliness and danger of the overhead distribution system had however forced the Company to seek a Provisional Order which would allow it to run the cables underground.

Although it initially offered its support, by April of 1895 Keswick Town Council was hesitant over the application. Recognising the financial potential of the scheme, by 1896 both parties had submitted license applications and in April of that year, as was protocol according to the 1882 Act, the Order was granted in favour of the Council. The license was later transferred to the Company for the period of forty-two years. The station remained operational until 1940 when it closed after electricity supply duties were taken over by the Central Electricity Board in 1938 (Tucker 1976). In the mid-1970s Tucker (1976) found the (albeit dilapidated) remains of the installation abandoned. Of the eight schemes Tucker surveyed, along with Lynmouth and Worcester this was the only installation where evidence of the sites' industrial past remained.

4.2.10 Milngavie, November 1894[130]

The hydro-electric scheme at Milngavie was constructed by local Provost, builder, philanthropist and "burgh improver" John Woodburn for the lighting of residences and shops on Clober Crescent, dwellings that he had also constructed, along with a substantial number of other houses, for the growing Glasgow commuter population (Orr 2002: 23). The installation was powered by water from the Tannoch Loch, marshland specifically flooded by Woodburn for the construction of a reservoir to power the scheme (Peters 1993). Common to the opening of electric lighting installations in the late-Victorian era, an opening ceremony was held in the public hall, a practice which reflected the position of

[130] Despite the potential identification of an archive for the installation at Milngavie, given the geographical location and the significance of the scheme, further investigation into the nature of this archive was beyond the feasibility of the study. However, two local history publications provide some particulars of the installation (see Peters 1993 and Orr 2002).

electric light as a symbol of technological modernity and subsequently a source of civic pride. Refreshments were provided and several toasts made, one of which was made by Bailie Bissland to "The old licht and the new licht" acknowledging both the arrival of electric light but also not wanting to antagonise the Gas Manager who was also in attendance (Orr 2002: 23). Orr (2002) proposes that the residential improvements made to Milngavie by John Woodburn were what attracted wealthy Glasgow commuters to the town. This included the electric lighting provision which evidently helped to position Milngavie as a salubrious residence for the local gentry and which thereby reinforces the notion of electric light as a symbol of wealth and Victorian aspirational living.

4.2.11 Fort William, August 1896

Less than two years after the opening of Milngavie, Scotland's third station opened at Fort William[131]. It would seem that the development of the plant was partially driven by the burgeoning tourist industry of the West Highlands which, during the summer months of the late nineteenth century brought tourists in their droves visiting the area to hike, in particular up Ben Nevis, a growing popular activity within Victorian Scottish tourism. Tourism was thus an integral factor to the development of Fort William's hydro-electric station: The West Highland Railway had opened some two years earlier connecting the previously remote western highlands to Glasgow and thus awakening Fort William from "an old world village" to "a more modern town"[132]. The opening up of communication infrastructures in the region connected Fort William to larger urban centres from

[131] 'Electric lighting by water power at Fort William', *The Electrical Engineer*, March 5 1897, 294-295
[132] *Ibid*: 294

which travellers brought with them the new ideas, cultures and accoutrements of late-Victorian urban living, including electricity. The newly constructed West Highland Railway therefore facilitated the flow of ideas and inventions from arguably more modernised urban environments from which they'd travelled.

The engineer of the Fort William scheme was Mr. R. Frederick Yorke an Associate of the Institute of Electrical Engineers who demonstrated a portfolio of successful systems in several large houses in the Highlands, also powered by water[133]. Earlier in the year Yorke had proposed a water-powered scheme which was subsequently abandoned due to difficulties over the water rights[134]. A subsequent scheme was proposed and this time supported by the proprietors of the water rights was adopted and the Fort William Electric Light Company subsequently formed. The water was harnessed from the River Kiachnish, a river exhibiting several falls and thus the motive force to effectively power a turbine at a point three miles east of Fort William. A dam was constructed "some distance" up the river and an open lade (or mill race) channelled the water to two turbines from where the power was transferred to the town along overhead wiring through which it was distributed along an underground cable circuit. The public lighting consisted of six arc lamps in the main street: three overhung ornamental lamps; two presentation lamps fitted with horses drinking troughs at their base and one with a fountain. This latter installation provided the subject of the graphical illustration to a substantial report on the new facility in *The Electrical Engineer* published several months after its first operation[135]. Depicted here in figure 4.2.11, the illustration not only shows the ornamental nature of the street lamp but

[133] *Ibid.*
[134] The idea of competing rights to water resources is explored further in chapter 5.
[135] See footnote 131

also suggests the centrality of the light to the expanding tourist location within an otherwise remote and rugged imposing landscape. Unfortunately the exact location of this lamp is not recorded but the illustration suggests its proximity to the water's edge thus providing light to the immediate locality but also a geographical and cultural reference point to Fort William's remote hinterland potentially drawing further tourist trade. The side streets and lanes were lit with incandescent lamps which in the tradition of Victorian electric lighting provision were fitted to the existing gas standard lamps with the addition of an ornamental top and globe.

The supply of electricity from 1st August 1896 proved popular. The current was reportedly

> very rapidly taken up, consumers coming on as fast as they could be wired and connected; there being amongst them six hotels, three churches, the Belfort Hospital, court house, and also the prison, and all the principal shops and dwelling houses[136].

For a tourist destination such as Fort William, it was in its best interests for its principal public buildings, particularly hotels and guesthouses to adopt the new facility. Like that at Lynmouth, the provision of electric lighting was an important

[136] *Ibid:* 295

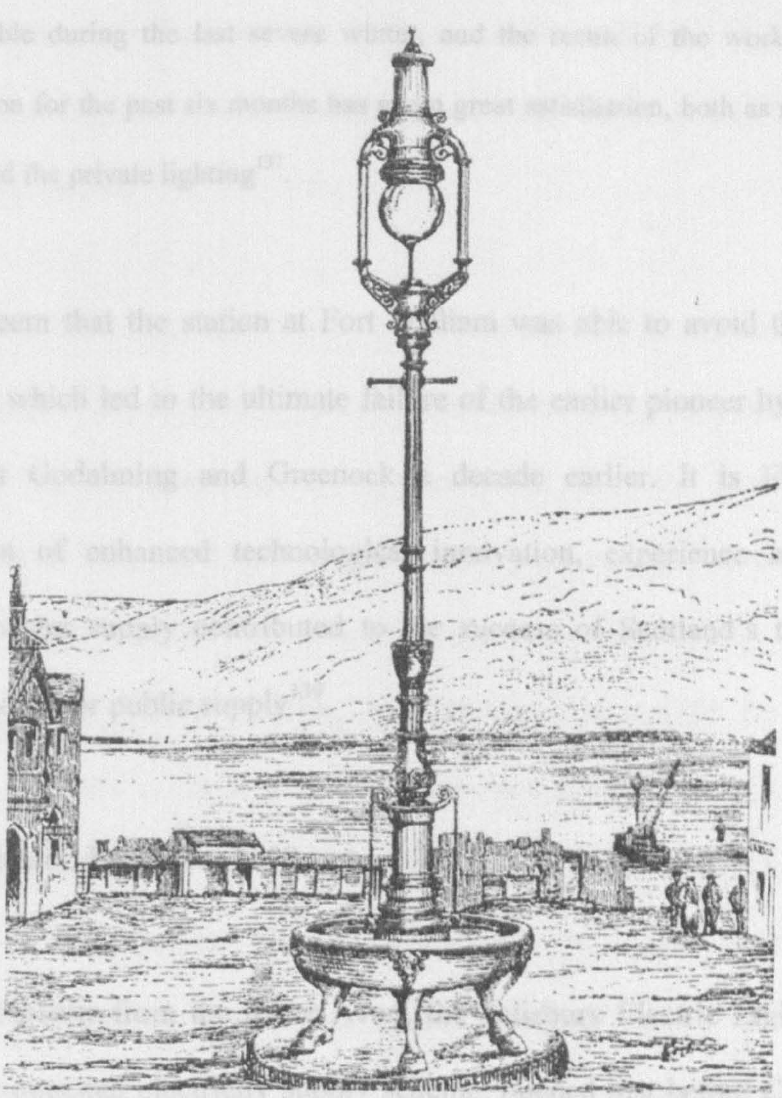

Figure 4.2.11 Sketch of lamp post and fountain at Fort William
Source: *The Electrical Engineer*, March 5, 1897

civic 'enhancement' with the potential to attract increased numbers of visitors and thereby further stimulate the local economy which was by now benefiting from the increased number of tourists transported to the town by the West Highland Railway. In addition to its popularity, the water power was also very reliable, the provision reportedly never giving any trouble during the last severe winter, and the result of the working of the installation for the past six months has given great satisfaction, both as regards the public and the private lighting[137].

It would seem that the station at Fort William was able to avoid the technical difficulties which led to the ultimate failure of the earlier pioneer hydro-electric schemes at Godalming and Greenock a decade earlier. It is likely that a combination of enhanced technological innovation, experience and a more reliable[138] water supply contributed to the success of Scotland's third hydro-electric scheme for public supply[139].

4.2.12 Salisbury, December 1898

Drawing its power from the River Avon, the Salisbury Electric Light station, a municipally operated electricity supply scheme, opened just before Christmas on 18th December 1898[140]. A report in *The Electrical Engineer* published a week later was typically accompanied by several hand drawn plans and sketches of both the site and the mechanical workings of the scheme[141]. The location of the undertaking in the town centre, had hosted a watermill since the thirteenth

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[137] *Ibid.*

[138] Given that the water source had a natural series of falls which afforded it a powerful head of water technical intervention to create this was not necessary

[139] The article mistakenly cited Fort William as the first hydro-electric scheme for public supply in Scotland. It is possible that the experimental nature of the Greenock scheme, in addition to the fact that it had now closed, meant that it was not considered significant.

[140] 'Salisbury electric light station', *The Electrical Engineer*, 23 December 1898, 818

[141] See *The Electrical Engineer* 22, 23rd December 1898. Reports of the installations at for example Godalming (see *The Graphic*, 12th November 1881), Greenock (see *Engineering* 40, 1885, 50), Lynmouth (see *The Electrical Engineer* 23, 1890), Keswick (see *Proceedings of the Institute of Civil Engineers* 102, 1890) and Worcester (see *The Electrician* 33, 5th October 1894) carried similar illustrations.

century[142]. The centralised position of the site and its industrial history prompted *The Electrical Engineer* to comment that a better site for the works "would hardly be possible to secure"[143].

In August of 1897 Salisbury Town Council advertised for tenders for electric street-lighting. Typically, the Council's decision to adopt an electricity supply was based on an unsatisfactory contract with the Gas Company which extinguished its lamps at 11pm for part of the year. In addition to an extended supply, the electric light company offered a reduced rate thereby securing the contract for three years and saving the Corporation over £500 per annum. As demonstrated in the cases of both Milngavie and Worcester (see chapter 5) it became the tradition for electricity generating stations to be opened by ceremony. Salisbury was no exception. The formal opening of the hydro-electricity works was an upmarket affair composed of several hundred guests, speakers, lavish decorations and a banquet at the local hotel. The ceremony was presided over by a Mr. Gramshaw, the chairman of the operating company who "ventured to prophesy from what he knew of Salisbury, that the station would soon follow in the footsteps of most stations and have to be considerably enlarged, and in a few years would have to be doubled in size"[144]. Records to substantiate Gramshaw's prophesy have not been located, however, in its initial operating stages, despite variable levels of available water-power, a continuous and uninterrupted supply secured the success of the installation[145].

[142] 'Salisbury electric light station', *The Electrical Engineer*, 23 December 1898, 818
[143] *Ibid.*
[144] *Ibid.*, 822
[145] *Ibid.*

4.2.13 Monmouth, June 1899

The final scheme considered here opened at Monmouth in 1899. Despite the country's infinite natural resources, it was the only hydro-electric station for public supply to open in Wales prior to the turn of the century[146]. Prior to his researches into wider late-Victorian hydro-electricity for public supply D.G. Tucker had considered the hydro-electric station at Monmouth (Tucker 1974). The fact that the scheme was powered by water prompted him to describe the station as an unusual scheme, thus reaffirming the idea that despite its increasing appeal as a potentially cost-effective option, the use of water to power public electricity supply schemes during the late-nineteenth century remained a relatively uncommon practice, even to Tucker who was evidently still in the process of discovering its wider application in late-nineteenth century Britain on which he published his article two years later (Tucker 1976).

Aside from its employment of water-power the installation at Monmouth was peculiar in that it was a combined sewage disposal and electrical supply scheme, an aspect of the proposal that resulted in a six-year gestation period. What makes this scheme typical however was that its proposal initially arose out of a dispute between the local authority and the gas company over charges[147]. The dispute in the summer of 1890 stimulated the Monmouth Town Council to visit Fareham

[146] As discussed in chapter 2, hydro-electricity in Wales developed on a *large-scale* for both industrial and public supply purposes from the early twentieth century causing the Welsh uplands to become a highly contested landscape on grounds of both Welsh sovereignty and conflicting environmental interests.

[147] The gas company wanted to charge £4 per lamp per year instead of £3, the price preferred by the Corporation.

near Portsmouth to inspect the town's electric light station[148]. Impressed with what they witnessed it was decided to draw up specifications and advertise for tenders. However, the gas company subsequently agreed to drop the prise of gas lamps and the idea of bringing electricity to Monmouth was temporarily abandoned. Two years later in 1892 plans were being drafted on behalf of the Council for the disposal of the town's sewage, a project for which the use of water power had been proposed. At this suggestion, the Mayor thought it sensible to reconsider the idea of water power for electricity generation. Ever-mindful of cost-efficiency, it was thought that the profits from the hydro-electric scheme might offset some of the costs of the sewage disposal scheme.

The intended location of the hydro-electric works was originally the east bank of the River Wye. However concerns over the available water-power caused the consulting engineers Messrs Bramwell and Harris to propose a new site at a disused mill near the centre of the town on the River Monnow where the engineers considered there was ample water power for the station. As with other installations, existing engineering works were re-used.

Typical of late-Victorian electricity supply schemes, competition from the gas industry threatened to hinder the introduction of electricity. In a potential case of industrial sabotage a newspaper campaign objecting to the supply first appeared in June 1895. Objectors attempted to divert attention away from their real motives by arguing that the local community had not been consulted suggesting that the majority were against the introduction of the electric light. The Council was urged

[148] This station was powered by steam and not water.

not to proceed without the sanction of the ratepayers. When the Local Government Board held an inquiry into the Corporation's request to borrow what had increased to £19000, a petition against it was submitted, signed by 100 ratepayers. However, the real source of opposition to the new facility was soon revealed when the Town Council observed and commented on the number of directors and shareholders in the gas company appearing on the petition. Contrary to the suggestions of the Gas Company it would seem that the wider electorate were in favour of the scheme as it was reported in mid-November that:

> The result of the municipal election is taken as showing that the ratepayers are favourable to the proposed electric lighting scheme, the retiring councillors who supported the scheme having been re-elected by substantial majorities[149].

Whether the electric lighting scheme was a political issue during the election is unconfirmed, but this is certainly implied by Tucker (1974) on this basis that these councillors were re-elected, thereby reinforcing the idea of wider cultural and political support for the introduction of electricity discussed earlier in the chapter.

By March 1896 the formal approval of the Board of Trade was obtained and a year later Siemens' tender, judged to be the lowest, approved. Despite the appointment of the engineers, the installation was still incomplete a year after the estimated completion date of April 1898. Financial troubles with the sewage disposal scheme had delayed the hydro-electric installation but by July 1898 it

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[149] Cited in Tucker (1974: 32)

was reported that "The work at the Generating Station is now in hand"[150]. Although it was reported in January 1899 that "the electric light is nearing completion and the light will probably be switched on by March"[151] it was June of that year before the station opened. By the beginning of 1900, private demand had risen sufficiently to justify the purchase of a fourth alternator, but this time to be powered by steam, almost doubling the available power of the station from 63kw to 123kw.

In 1922, the electricity generated at Monmouth failed to meet its demand. There was a subsequent request to purchase electricity from the Hereford electricity generating station (not water-powered). However, the Electricity Commissioner did not accept the terms of the negotiation and recommended instead that the Monmouth installation go ahead with an extension to its existing works. Tucker (1974) reports that two of the 21kw generators were replaced with one 40kw and one 30kw generator as well as the replacement of the large steam-driven generator with a new diesel-driven set. The works were later sold to the General Electric Company who kept the station operating until nationalisation in 1948 (Tucker 1974).

4.3 Conclusion

The summary of the twelve late-Victorian hydro-electric schemes considered here illustrates some of the pertinent issues within late-nineteenth century discourses of hydro-electricity presented in 4.1. Specifically, the commercial

[150] Cited in Tucker (1974: 33)
[151] *Ibid.*

rivalry between the gas and electricity industries, the re-use of existing but abandoned industrial space, the municipalisation of electricity and the emergence of electricity, specifically electric lighting provision, as a modernising endeavour. As stated in 4.2.1, an additional hydro-electricity station was opened prior to the end of the nineteenth century at Worcester; a further example through which these issues can be illustrated.

Instigated and operated by Worcester City Council, the electricity station, opened in October 1894, was constructed on the site of disused mill buildings at Powick Bridge approximately two miles south-east of the town astride the River Teme. With an unrivalled operating capacity of 400kw, Tucker (1976) regarded the station as the zenith of nineteenth century hydro-electric generation for public supply. Although Worcester was not the first example of local authority electricity supply, as demonstrated above it was not until four years after the opening of Worcester that similar municipal endeavours were undertaken; first at Salisbury in December 1898 and six months later at Monmouth in June 1899, it operated with a degree of longevity or success again unrivalled by other late-nineteenth century hydro-electric developments. The significance therefore of Worcester hydro-electric station to late-nineteenth century electricity generation as both the first substantial electricity supply station (on the grounds of operating capacity) and one which was powered by water, as well as the survival of a rich archive of local authority and private manuscripts, contributed to the choice of Worcester as a major illustrative case study within the thesis and which constitutes the subject of the following chapter.

5 Hydro-Electricity and the Civic Improvement of Worcester

The City of Worcester was the first local authority in Britain to construct and operate with any longevity its own hydro-electric power station for public electricity supply. On its completion in 1894 it was the largest scheme in Britain to open before the turn of the twentieth century (Tucker 1976). The plant was located at Powick on the river Teme approximately a mile from its confluence with the River Severn, the location of which is shown in figure 5 which also shows its position in relation to Worcester and the surrounding area. The site's history is again intimately connected with water power there having been several watermills recorded here in the Domesday survey and three existing at the time of the construction of the hydro-electric power plant.

As discussed in chapter 4 particular to late-Victorian civic governance was the practice of municipal socialism, the principle that the welfare of citizen's and thus the provision of public utilities should be the responsibility of the local authority for the collective benefit of those under its jurisdiction. In a typical example of this practice it was the considered duty of Worcester City Council that under the conditions of the 1888 Electricity Act it should apply for a Provisional Order to supply the town with electric lighting. The plant was opened in October 1894 by the City Mayor who in his speech, drawing on the co-operative principle, stated that every ratepayer would be a shareholder in the provision. To further promote the new facility, The Mayor also drew on the scheme's benefits to public health and Worcester's collective local economy, Mayor stating that the Council would be selling a commodity "which was a distinct advantage to the health of those who used it in preference to gas for illuminating purposes and also would be a cheaper substitute" (quoted in Tucker 1976[1]).

The chapter continues by considering the development of Worcester's hydro-electric station from a largely chronological approach. Beginning with its initial formulation by Worcester City Council through to its closure during the inter-war period, emphasis is placed on the embryonic stages of its development and the challenges faced by the Corporation in bringing the new facility to Worcester.

[1] Unspecified reference

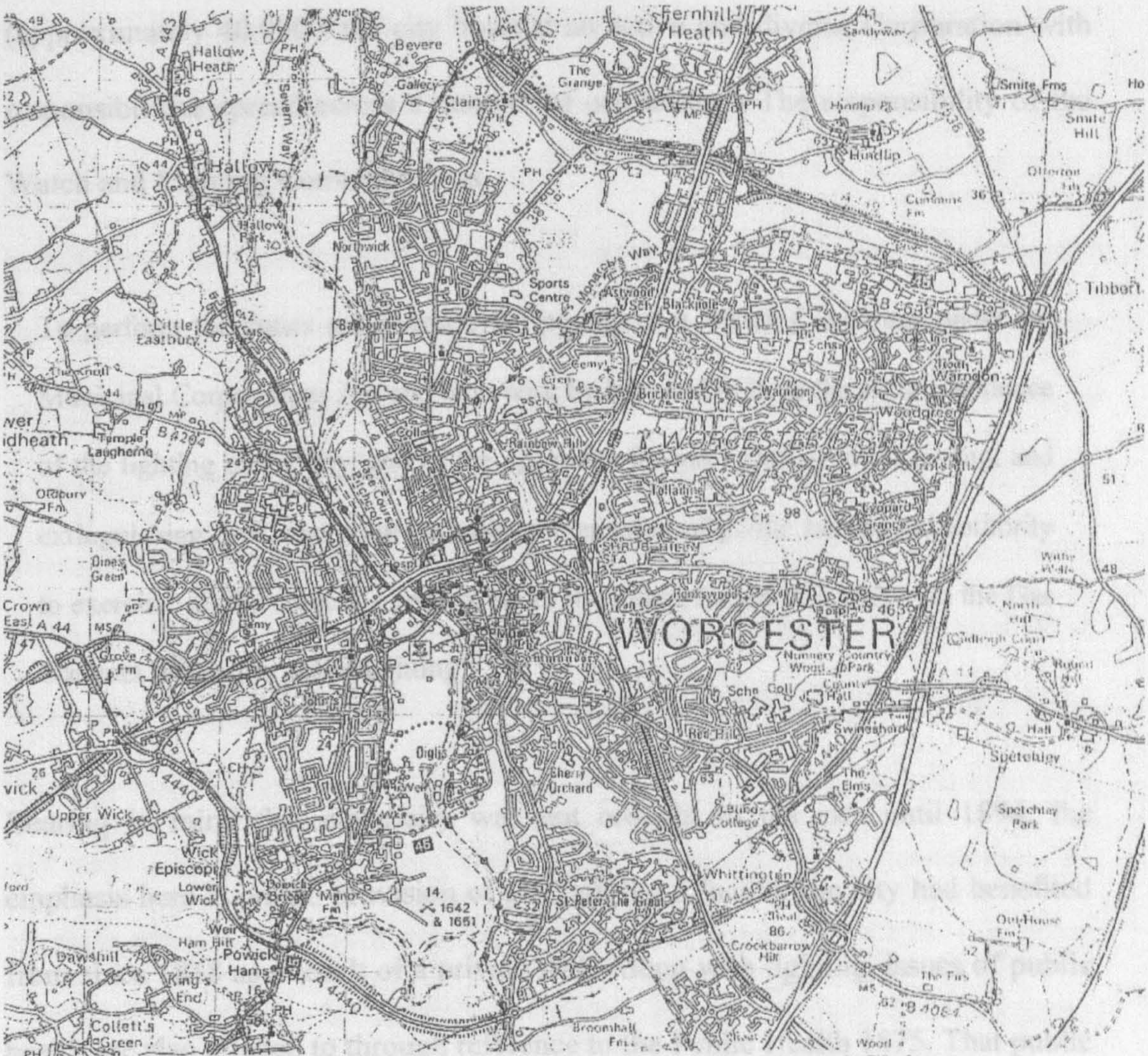

Figure 5 Map of Worcester showing Powick, Diglis and Claines
Source: OS 1:50000 Landranger Series

5.1 Worcester City Council and the Provisional Order

Worcester's hydro-electric station was opened by grand ceremony on 11th October 1894. The Council's interest in constructing an electricity generating station for the city had however been stimulated over a decade prior to this as a result of legislation contained in the 1882 Electricity Act. In Worcester, responsibility for the provision and control of public lighting and hence public electricity supply came under the jurisdiction of the Watch and Lighting Committee of the Council. By 1882, despite a relatively small population (approximately 40,000[2]) the city boasted an active and diverse Corporation with responsibilities spread across a number of committees. The responsibility of the Watch and Lighting Committee was

> To perform the duties and exercise the powers of a Watch Committee under the Municipal Corporations Act and otherwise by law, and to have the superintendence of the lighting of the city, and of the apparatus for gas lighting, meter testing, and extinguishing fires, and power to order the erection of public lamps, and authority to exercise, all the council's powers under the Public Health Act 1875 and the Gas Contract relating to public lighting[3].

Bearing in mind that electricity was not brought to the city until 1894, the emphasis here is on the provision of *gas* lighting a facility the city had benefited from since 1818 as a result of a private Bill. Along with lighting, issues of public health are also alluded to through reference to the Public Health 1875. That public lighting came under the same jurisdiction as matters of public health bears relevance. To deviate momentarily, as discussed earlier, central to the practice of civic improvement in the Victorian era was the amelioration of public health and sanitation. As a corollary to the improvement of public health, matters of water and its control were integral. This was predominantly from a health and sanitation perspective, but as discussed earlier, the practice of urban reform extended to matters of public safety, morality and social order, all of which could be better controlled through the provision of public lighting. Water and its municipal control were therefore central to the practice of civic improvement through both

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[2] 1881 Census data. Source: www.statistics.gov.uk/census2001/bicentenary/pdfs/worcestershire.pdf (accessed 15/5/06).
[3] Watch and Lighting Committee Minute Book 1876-1889, Worcester City

its role in the provision of public lighting and through its connection to the improvement of sanitation and through this, public health.

Returning to Worcester's gas lighting provision, this was a comparatively early development as far as the wider practice of civic improvement in Britain was concerned: Acts and Bills for towns and cities such as Newcastle-under-Lyme, York and Dalton and Furness were not passed until the 1870s[4] thereby distinguishing Worcester as a comparatively progressive city. By the 1870s Worcester City Council held a contractual agreement with the Worcester New Gas Light Company which was renewable on an annual basis[5]. The passing of the Electricity Act in 1882 however offered potential benefits to all municipalities and their citizens which Parliament actively encouraged city corporations to consider through the application for licenses or Provisional Orders. Worcester applied for its licence in 1890; however, the idea of bringing electric light to Worcester had been under consideration for some time.

The prospect of electric light had been brought to the attention of the Council prior to the passing of the 1882 Act in April of the same year when a copy of the Electric Lighting Bill was presented to the Committee by Alderman M. G. Hill[6]. After close inspection it was moved that the Mayor, Walter Holland, the Sheriff, Alderman's Woodward and Townshend and Mr G. H. Williamson "be a sub-committee to consider and report as to the provision of the Electric Lighting Bill 1882 and to the course that should be taken by the Council with reference

[4] Acts and Bills for Gas Lighting 596.5, CAB 15, Box 1
[5] Watch and Lighting Committee Minute Book 1876-1889, Worcester City
[6] 28th April 1882, Watch and Lighting Committee Minute Book 1876-1889, Worcester City

thereof"[7]. A week later on the 5th May 1882 at a meeting of the newly elected Electric Lighting Sub-Committee the Bill was discussed. A meeting of the Government's Electric Lighting Select Committee was held a few days later on the 9th May. The Council did not attend the meeting but despite some minor concerns regarding the autonomy of the Corporation on work done to overhead cables and the making of bye-laws, it supported the Bill.

The new legislation effectively created a brand new industry in electric lighting provision, a situation upon which the burgeoning electric lighting companies intended to capitalise. Local Authorities, including Worcester Council were flooded with requests from such companies for permission to apply for Provisional Orders. The Act stated that private companies or individuals must have prior permission from the supplying municipality when applying for a license to supply electricity. Additionally, in the event of both a private company or individual and a Town Corporation applying for a license simultaneously preference would be given to the municipality in every case. By the middle of September 1882, less than a month after the 1882 Act had been passed, Worcester Council has received requests from the Hammond Light and Power Supply Company, Messrs. Walter Webb and Co. of London, the Edison Electric Light Company, the Gulcher Company, the Jablochkoff Company and the South Staffordshire Electric Lighting Company[8]. Undecided as to how to proceed, the Town Clerk was instructed to reply to the companies to inform them that the Corporation was presently considering its own application. The Town Clerk was

[7] *Ibid.* George Henry Williamson was later elected and Mayor and was therefore integral in bringing hydro-electricity to Worcester.
[8] 15th September 1882, Watch and Lighting Committee Minute Book 1876-1889, Worcester City. A retired Russian army officer, Paul Jablochkoff was one of the first engineers to experiment with and develop an arc lighting system in the 1870s (Byatt, 1979).

also instructed to acquire a copy of the Act and the rules and regulations thereof for the consideration of the Committee.

In an effort to encourage local authorities to apply for licenses, the Board of Trade wrote to Worcester Council reiterating 'rule 2' of the Act which gave priority to applications from Corporations[9]. Potentially encouraged by this information, it was resolved that the Corporation should apply for a license to supply Worcester and a small ancient parish three miles north of Worcester called Claines and to instruct each of the companies as to this decision (see figure 5)[10]. It was for this reason that the Hammond Company wrote to the Corporation on September 1882 stating its intention to withdraw its application for a licence as it "had no intention to act in competition with the council"[11]. Competition for the Provisional Order from various electrical engineering companies evidently prompted the Council to come to a decision on the issue. However, despite this seeming commitment to bringing electric lighting to Worcester, the Council's approach to the matter over the following seven years was characterised by indecision and procrastination.

In response to the Council's decision, intent on capitalising on the opportunities offered by the recent Act, several of the electrical engineering companies who had intended to apply for a license for Worcester (the Edison, Jablochkoff, South Staffordshire Electric Light, Gulcher and Hammond Companies) subsequently offered their electric lighting systems for inspection or their services for the

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[9] 22nd September 1882, Watch and Lighting Committee Minute Book 1876-1889, Worcester City.
[10] No further information was minuted as to why Claines was delineated for supply.
[11] Letter from the Hammond Company to Worcester County Council dated 25th September 1882, CAB 21 Box 1, Worcester City

Council's disposal pending the granting of a Provisional Order[12]. The Hammond Company offered to keep the Council "regularly informed of all improvements that are taking place in the electric light world"[13]; similarly Heaton Snowdon, the Crompton Company's representative offered to keep the Corporation supplied with beneficial information, specifically which company performed its contracts most efficiently, thoroughly and economically[14]. Similar offers were made by the Jablochkoff Company which was "happy to furnish the Corporation with information on their electric light system"[15] and the Gulcher Company recommending their system[16]. Recognising the potential business opportunity should the Council be successful in its application for a licence, by offering their services the companies hoped to secure a more permanent position with the Corporation to develop Worcester's electricity generating station. However, their offers were ultimately made in vain, as none of the aforementioned companies were subsequently employed by the Corporation despite sometimes repeated solicitations.

5.2 Gas v. Electricity Provision in Worcester

Meanwhile, Worcester continued with its gas lighting provision and renewed its contract with the Worcester New Gas Company for a further year until 31st December 1883[17]. For gas companies the Act posed a significant threat to their

[12] Minutes of 29th September 1882 and 13th October 1882, Watch and Lighting Committee Minute Book 1876-1889
[13] 10th October 1882, Watch and Lighting Committee Minute Book 1786-1889
[14] As in REB Crompton, the pioneering engineer who had collaborated with Joseph Swan on incandescent lighting installations in the early 1880s.
[15] 25th September 1882, Watch and Lighting Committee Minute Book 1876-1889, Worcester City
[16] *Ibid.* 23rd October 1882
[17] *Ibid.* 14th November 1882

commercial viability. Where they had previously enjoyed an unrivalled position as a public supplier of artificial light, suddenly a new form of potentially brighter, cleaner and significantly, what was perceived to be a *safer* form of artificial lighting was available. The only way for the gas companies to stave off this competition was to lower prices and improve service provision, which was the response of the Worcester New Gas Light Company to the 1882 Act. In the November following the ruling, the Gas Company wrote to the Council to advise it of a reduction in its costs and improvements to the street lighting through an increase in the number of lamps in several of the main streets in the town. The proprietors of the company were John Stallard and John Stallard junior. A 'John Stallard' also sat on the Watch and Lighting Committee. As discussed in chapter 4 it was not unusual in Victorian civil society for local businessmen to also take an interest in civic affairs, so it is likely that they were one and the same person. In this instance it can be speculated that this relationship played a significant role in the continuation of the contract between the Corporation and Gas Company.

The extension of the gas contract served albeit temporarily to supplant ideas about the electric light and the following year was characterised by procrastination in the Council's decision to implement a public electricity supply system. Despite the Corporation's stated intention at the end of 1882 to apply directly to the Board of Trade for a Provisional Order, the issue had since remained dormant. Two offers to contract for the electric light had been received in the first part of 1883 from the Jablochkoff and the Telegraph Construction and Maintenance companies but no response was made. However, a further correspondence from the Electric Construction and Maintenance Company on 6th July 1883 announcing its intention to apply for a Provisional Order in the session 1883-84 this time prompted a response from the Council which wrote to request confirmation of its intentions. The Council was evidently still evaluating its options regarding gas or electricity provision as the Gas Company was also contacted to ascertain its terms for both one year and for a further three years[18]. Despite its earlier zeal for electric light, the Corporation was now open to a further continuation of the gas supply if favourable terms were offered. A fortnight later however, still awaiting a response from the Gas Company, on 17th August 1883 the Committee resolved again to apply for the PO directly and the Electric Construction and Maintenance Company was informed of this decision.

Despite this notification of intent[19], the Council's indecision continued. At a meeting on 8th November 1883 it was decided to postpone the publication of the advertisement until it was aware of the intentions of the Electric Construction and Maintenance Company. Finally, on 23rd November, the final day of the session during which could it could submit its application the Council deviated from this decision. Furthermore, in the following February, despite the fact that it had failed to make an application itself, the Council denied the Hammond Company's request to develop an electrical installation in Worcester. Such behaviour thereby support's Hannah's (1979) claim that municipalities stifled the development of the electric lighting industry through their slowness to establish public supply

[18] 3rd August 1883, Watch and Lighting Committee Minute Book 1876-1889, Worcester City

[19] The draft advertisement, dated merely '1884', stated that the Worcester County Council intended to apply for a PO licensing it "to supply electricity for public and private purposes, as defined by the [Electricity Act 1882] within the area hereinafter described; to empower the Corporation to open and break up the streets and bridges; to alter the position of gas and water mains, pipes and wires, sewers and drains under the dams, to acquire lands, to appropriate lands (whether devoted to any special public service or not), to construct such works, acquire such licenses for the use of any patented or protected processes, invention machinery apparatus methods materials or things". CAB 21 Box 1, Worcester City

systems. The reasons for this state of constant prevarication are unexplained. However, evidence relating to the Council's contract with the gas company suggests it played its part in this decision. In an effort to retain its position with the Council, as gas was not able to compete on grounds of technological merit the Gas Company had no alternative but to reduce its prices which it did for a three year period from the end of 1883. The Gas industry therefore was able albeit temporarily to stave off competition from the new facility, thereby implicating industrial competition in the suppression of bringing electric light to Worcester.

The extension of the gas contract effectively worked to rid the matter of electric light from the Council's collective consciousness. During the proceeding five years the matter was minuted a mere three times, each time recording correspondence from various electrical engineering companies offering to tender for the electricity works despite the fact that a PO had neither been applied for nor granted to the Local Authority[20]. In each case no action was taken. However, events which transpired during this period contributed to a change in attitudes regarding the electric light after 1889. Since its renewal at the end of 1883 the gas contract had also virtually disappeared from the agenda until its expiration in October 1886, when it was agreed to renew the contract for a further three years on the proviso that the luminance was good, the lamps were kept in satisfactory working order and that they were lit and distinguished at the Corporations stipulated times[21]. However, before the contract was finally agreed on 24th December 1886, a dispute ensued over the price of lamps. Several meetings were

[20] Watch and Lighting Committee Minutes 31st January 1884 to 15th February 1889, Worcester City

[21] 15th October 1886, Watch and Lighting Committee Minute Book 1876-1889, Worcester City. The Council requested a 30 minute margin either side of the agreed summer and winter lighting up times depending on special circumstances.

held between the company Chairman John Stallard junior and the Mayor Walter Holland, but even by October 1887 the matter was unresolved. It transpired that there were ultimately ten points of contention between the Council and the Gas Company relating to issues of illuminating power, maintenance and burning time[22]. The cost of the contract had seemingly been settled. Although some movement was made towards an agreement by both parties they remained deadlocked on two points. The matter was eventually settled by arbitration on 13th April 1888 after much deliberation between the two parties[23].

Despite this eventual settlement, the effects on contractual relations between the two parties had evidently taken its toll. Additionally, and perhaps more significantly, a new Mayor had been elected in November 1887. George Henry Williamson was a member of the Conservative Association and (although subsequently unseated by petition on charges of corruption) was elected Member of Parliament for Worcestershire in 1906 (Worcester Conservative Association 1978). Williamson was evidently an ambitious Councillor with political aspirations beyond the scope of local authority rule. Byatt (1979) argues that although local authorities were competent, they were generally not pioneer innovators. The civic improvements made to Worcester during Williamson's Mayoral session can therefore perhaps be partly understood as the legacy of an individual keen to make his political mark on the City. The election of Williamson, a Mayor who, as custodian of Worcester's municipal reputation, was prepared to sacrifice established contractual relationships in favour of real 'civic

[22] *Ibid.* 7th December 1887
[23] Watch and Lighting Committee Minute Book 1876-1889, Worcester City

improvement' - if only for his own political advancement - certainly marked a change for the development of Worcester's electric lighting.

1888 marked a significant year for the development of hydro-electricity in Worcester. The closing of a bitter dispute between the Corporation and the Gas Company and the election of a new Mayor were coupled with amendments to the 1882 Electricity Act resulting in the improved 1888 Act. These combined political events, after half a decade of relative neglect, brought to the fore once more the issue of the electric light for Worcester Council which, as a result of the amended Act[24], from the spring of 1889 witnessed a new flood of enquiries from electrical engineering companies as to the Council's position concerning its application for a Provisional Order[25]. On 16th August 1889 it was decided that the matter of the electric light was again to be postponed and considered in the autumn. Finally, after half a decade of procrastination and prevarication at a meeting of the Committee on 11 October 1889 it was passed that the Council should apply to the Board of Trade for a Provisional Order under the Electric Lighting Acts, authorising the council to supply electricity in Worcester.

It would seem the Council had at long last come to a decision. On 20th November 1889 the City Surveyor submitted a description of the proposed area of supply to the Council which would be required for the licence application. He also recommended £15000 to be expended in connection with the undertaking which

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[24] The main amendment to the Act was the increase of the reversionary purchase clause from twenty-one to forty-two years, thereby allowing for a longer investment period in which investors could expect a profitable return.

[25] Those companies were the Anglo-American Electric Light Corporation, Laing Wharton and Down Construction Syndicate Limited, Crompton and Company, the Midland House to House Electricity Company, the Electric Construction & Maintenance Company and the Municipal Electric Light and Power Corporation.

should be raised by Corporation stock charged in the rates. The following month a draft of the Provisional Order was received from the Board of Trade and distributed to each member of the Gas Sub-Committee. A month later it was moved that it should be approved and adopted. A Provisional Order was subsequently granted to Worcester Council on 31st January 1890 for the provision of electric light to the city of Worcester.

5.3 Water as a Contested Resource I: Competing Claims to the River Severn

During its seven year period of gestation no mention of the source of power was recorded in the Committee records in connection to Worcester's proposed electricity station. However, on receipt of the Provisional Order objections to the licence were received from a group recorded in the Council minute book as 'the Severn Commissioners'[26]. This entry referred to the Severn Commission, a Parliamentary commission appointed in 1842 as a result of a Bill brought by the Severn Improvement Association to take tolls in return for improvements to the river which included the construction of locks and weirs (Vellacott 1906; Paget-Tomlinson 1993)[27]. The fact that the Severn Commission had written to the Council to object to the licence suggests that the use of water-power, specifically

[26] 31st January 1890, Minutes of the Watch and Lighting Committee 1890-1893, Worcester City

[27] Demands for the improvement of the River Severn intensified during the 1830s, to the point at which a Severn Navigation Company was formed, although its Bill was defeated in 1837. In the same year the Worcester and Birmingham Canal Company promoted its own Severn Improvement Company, which came to an agreement with the Severn Navigation Company in 1838 and together formed the Severn Navigation Improvement Company, which introduced a new Bill but was defeated by the opposition of the Staffordshire and Worcestershire Canal Company. The Improvement Company was wound up in 1840 and a new Severn Navigation Improvement Association formed to press for a Bill to set up a Severn Commission; the Act authorizing this was passed in 1842 (Severn Navigation Improvement Association (D2460/1), Records of the British Waterways Board and predecessor bodies, Gloucester Record Office).

from the River Severn, had been mooted prior to the granting of the license. The River Severn which meandered through Worcester was a significant and sizeable water-course thereby making it an obvious and reliable source of power. The proximity of the Severn to the town and its use as an industrial transport route meant that coal would have been easily transportable to Worcester and therefore equally as feasible as a means of power. However, towards the close of the nineteenth century concerns over both the availability of coal reserves and its increasing price (Supple 1987) were sufficient to stimulate electricity supply operators to consider alternative options, such as water-power which was both free and in certain regions of Britain, abundant.

Returning to the Severn Commission it is likely that given its jurisdiction its opposition to the Provisional Order related to concerns relating to the navigability of the Severn, which, the absorption of water for a hydro-electric station had the potential to threaten. The Severn had historically been subject to "violent changes of level" as the flood waters came down from Wales, which traditionally rendered the river unnavigable (Paget-Tomlinson 1993: 186). But as a result of the construction of a series of locks and weirs between Gloucester (to the south of Worcester) and Stourport (to the north), including that at Diglis in the 1840s, a depth of between seven and ten feet was maintained (Vellacott 1906; Paget-Tomlinson 1993). The Severn Commission's objection contributed to an already long history of conflict over claims to the navigation of the River which had been the subject of often fierce disputes from an early period between those wishing to use the river for transportation purposes and neighbouring landowners who demanded tolls (Vellacott 1906)[28]. However, an Act of 1430 rules that the river Severn "is common to all the king's liege people to carry and re-carry all manner of merchandise, as well as in trowes and boats as in flotes, otherwise called drags" (quoted in Vellacott 1906: 250). Despite petitions, inquiries and the passing of several Acts against toll-charging between 1430 and 1532 the practice continued. Although no further mention of these objections is made at this point, later negotiations with the Council showed that the group did not readily acquiesce in their opposition to the use of the Severn.

Meanwhile, the Watch and Lighting Committee engaged itself in investigating further the matter of bringing the electric light to Worcester. Despite obtaining a licence, it seems the Council continued to waver in its commitment to the project. Nevertheless, between October 1890 and September 1891 the Council proposed to equip itself with the necessary information to operate such a scheme, predominantly through consultation with other towns which had already implemented municipally operated public electricity supply schemes. Information was sought from Bath, Brighton, Colchester, Godalming, Leamington and Norwich[29]. Specifically, the Council sought information as to whether the electric light was "cheaper and better than gas as a public light" and rather ambiguously

[28] No specific dates are mentioned.
[29] 10th October 1890, Minutes of the Watch and Lighting Committee, Worcester City. An undated document archived by the Worcester County Council (CAB 21 Box 1) comprehensively lists towns granted Provisional Orders. These were Bacup, Barnsley, Bedford, Birkenhead, Blackburn, Blackpool, Bradford (the first municipally operated steam-powered station in Britain (The Electricity Council 1973a)), Brighton, Bristol, Burnley, Burton-on-Trent, Bury, Bury St. Edmunds, Cambridge, Carlisle, Cheltenham, Chester, Derby, Dover, Grantham, Great Yarmouth, Huddersfield, Kingston-upon-Hull, Lancaster, Manchester, Oldham, Portsmouth, Salford, Scarborough, Walsall, Wigan, Wolverhampton and Worcester. Of this exhaustive list none were powered by water. This document must have been dated earlier than 1892 as Bath, Colchester, Leamington and Norwich do not appear in this list. Godalming is also absent from this list but by 1884 it had closed which must date the document post-1884. This tells us which towns at a certain point in time had been granted POs.

"the best way of introducing the electric light into the city"[30]. During this period the Committee also resolved to investigate the price that should be charged for electric light and in an early demonstration of public participation the Council also resolved to consult the citizens of Worcester as to whether they would be willing to take the new provision, to which one particular response from the Post Master - in favour of the electric light - was recorded[31]. Presumably having collated and digested this information which indicated the installation would be a potentially worthwhile endeavour, it was resolved to advertise for the invitation of tenders in *The Times*, *The Engineer* and two other unspecified electrical newspapers[32]. The advertisement invited

> persons or companies desirous of tendering for the construction of electric lighting works in the city to submit plans, detailed descriptions and estimates of cost for constructing the works they think necessary for enabling the council to supply electricity equivalent to 12000 10 candle power lamps hung in a district extending northwards as far as McNaught and Co's works ... eastwards as far as the Shrubhill Station, southwards as far as the Canal and westwards to the Severn with the view if the Committee so decide of laying such plans, descriptions and estimates before an electrical engineer of eminence to advise the Council as to which should be accepted[33].

[30] 10th October 1890, Minutes of the Watch and Lighting Committee 1890-1893, Worcester City
[31] *Ibid.* 11th September 1891
[32] *Ibid.* 29th October 1891
[33] *Ibid.*

The notices were published on 1st December 1891 with a deadline for submission of 13th February 1892. Fifteen tenders were subsequently received[34]. It was moved that William Henry Preece, eminent Victorian electrical engineer (predominantly in the field of telegraphy) and engineer to the GPO be appointed to advise the Council on the tenders for electric lighting works[35].

Advised by Preece who had consulted with the Newcastle-upon-Tyne Electric Supply Company, the Newcastle and District Light Company and the Sheffield Electric Light Company all of which had the Brush Company's system in operation, it was recommended that the its tender be accepted[36]. The Brush Company had been at the forefront of electric lighting technology for some time, C.F. Brush had developed his arc lighting system in the 1870s in the US and was thus was one of the first systems to be implemented in electric lighting installations in Britain. Although the Brush system was not considered as reliable or as complex as systems developed by Siemens it was considered cheaper (Byatt, 1979). According to the trade journals, along with Siemens, Brush held an unrivalled position within the industry as the most popular and commercially successful; even as early as 1881 in a report by the engineer Thomas Grierson which included a glowing report of the Brush system "the *most* popular of all" (Grierson 1881: 105).

[34] *Ibid.* 19th February 1883. The Minutes do not list each of the companies that applied. Although eight of these tenders remain in the Worcester City archive (CAB 21 Box 7) the remaining tenders do not, therefore a comprehensive list of companies that tendered cannot be made.
[35] Preece was Knighted in 1899 (source Hunt, B.J., www.oxforddnb.com, accessed 01/02/07)
[36] 25th March 1892, Minutes of the Watch and Lighting Committee 1889-1993, Worcester City Archive, WRO. There were reportedly criticisms about the Brush Company's system written in the newspapers (the publications were not specified) but the Council seemed satisfied with Preece's recommendation. *Ibid.* 25th March 1892

Although the rationale for the selection of the winning tender is not specifically recorded, the success of the Brush Company in securing the contract with Worcester Council may have related to proposals regarding water-power. Unfortunately the Brush Company's tender does not survive, however it can be deduced from later entries in the Committee minutes books that the Company proposed to draw water from the River Severn[37]. In its earlier correspondence with the Corporation the Company had initially been registered in the United States using a corresponding postal address but was now using a registered business address in London. The Brush Electric Light Corporation was an Anglo-American Company which had been set up as the British arm of Charles Brush's Brush Electric Company in America[38]. The *Anglo*-American company had been formed in 1880 in order to exploit the British rights to Brush patents (Byatt, 1979). As a company which had previously operated predominantly in the United States, its decision to use water-power makes sense as reports in the international trade journals *The Electrician* and *The Electrical Engineer* indicate that the use of water-power to generate electricity was more prolific on the other side of the Atlantic[39]. Regardless of its experiences with water-power, the Brush Company had developed an unrivalled reputation reflected by its lighting system sales[40], a factor which was undoubtedly integral to its appointment as electrical engineers to Worcester City Council.

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[37] *Ibid.*

[38] In 1889 the Brush Electric Light Corporation had taken over the assets of the British-based Brush Traction Company, whose main business was tramcar production. It then became known as the Brush Electrical Engineering Company (Byatt 1979). The Company's expertise in tramway systems may have contributed to the development of an electric tram system in Worcester in 1902 which was powered by hydro-electricity (see section 5.7).

[39] Although the Niagara Falls hydro-electric station didn't open until after Worcester, in September 1895, the idea of a hydro-electric station on the river had been under consideration since the late 1880s.

[40] '1881', *The Electrician*, 7 January 1882, 120-123

The original notification to invite tenders had not specified the source of motive power. Despite the proximity of Worcester to the River Severn, of the remaining archived tenders none based their plans and specification on the use of water-power, instead opting in each instance for coal powered steam. The justification for this as set out by the Manchester Edison Swan Company which did "not propose to make any use of the River Severn" was founded on economic efficiency stating that "Unless a large quantity of water can be obtained at a good head, the first cost of water power works is so great as to cancel the advantages of subsequent saving in fuel"[41]. As proposed above, the Brush Company's possible experience of using water-power in the United States perhaps afforded the Company the knowledge of developing such systems more cheaply than companies such as the Manchester Edison Swan Company which was perhaps less experienced with such technology.

To conclude these speculations on the Brush Company's appointment, as demonstrated in numerous articles in the trade journals hydro-electricity engineering was considered a novel and progressive form of power generation[42]. Reflecting the Victorian sensibility for thrift and efficiency, rhetoric about water-power 'going to waste' abounded within the engineering community amongst which there was a general consensus that this should be harnessed for the production of electricity as argued by Buchanan (1989 in Roberts 2006)[43]. Unfortunately the extent to which the use of water-power contributed to Preece's

[41] 13th February 1892, CAB 21 Box 7, Worcester City
[42] See for example Grierson (1881); Lane-Fox (1882); Fawcus and Cowan (1890); 'Hydro-Electricity', *The Electrician*, 25 March 1882, 300; '1881', *The Electrician*, 7 January 1882, 120-123; '1881', *The Electrician*, 14 January 1882, 136-139; '1881', *The Electrician*, 21 January 1882, 152-155
[43] *Ibid.*

recommendation to select the Brush Company's tender is unknown but it is possible that the Council anticipated that its significance as a novel and technologically progressive form of engineering would reflect impressively on the Corporation and help secure it a reputation as a modern and progressive Town Council, such was Williamson's appetite for political expedience.

Despite the Committee's satisfaction with the scheme, it was on the condition of several alterations recommended by Preece. These included extra works, additional street lighting and buildings and further connections and extensions warranting a further £20000 capital investment on top of Brush's original estimate of £20030. The Council intended to apply for a Loan of £40000 from the Local Government Board to accommodate the extra cost. Further interrogation of the proposal followed and at a meeting of the Watch and Lighting Committee on 25th March 1892 it was moved that the City Surveyor report on the practicality of utilising the River Severn near Diglis Weir for the motive power required for the Brush Company's engineers (see figure 5 for location of Diglis Weir). It was also moved that the Severn Commission and the Severn Fishery Board "be courteously informed of the proposal to utilise water power for electric lighting purposes"[44]. In response to this notification, a letter from the Severn Commissioners was received asking what payment the Council intended to make in respect of the advantages derived from the outlay made by the organisation in their works and as to the course proposed to avoid any injury to navigation[45]. The Severn

[44] 25th March 1892, Minutes of the Watch and Lighting Committee 1889-1893, Worcester City. Hereafter referred to as the Severn Commissioners and the Severn Conservators (as they were colloquially referred to) respectively.
[45] *Ibid.* 8th April 1892

Commissioners were clearly intent on protecting their charge, or at least exploiting the situation to their best advantage[46].

It would seem that both the Commissioners and the Conservators wielded considerable political influence over local planning issues in the late-Victorian period thereby illustrating the power of what might be characterised as the late-nineteenth century 'environmental lobby'. On receipt of the Commissioner's response not only did the Council continue to interrogate the Brush Company's tender through consultation with the electric light companies operating electricity stations at Hastings, Bournemouth, Lynmouth and Bath[47], it also investigated the option of steam power detailed in a proposal from the Electrical Power Storage Company[48], deciding only to *provisionally* adopt the tender of the Brush Company pending the receipt of a report from the Watch Committee as to whether provision should be made for steam power only or steam power combined[49]. The fact that the Town Clerk was ordered to send the plans of the installation to the both Severn Commissioners and Severn Conservators for their consideration further demonstrates the Council's prioritisation of the concerns of the two Severn interest groups. However, Preece was strongly in favour of the use of water power, a view he made known at a meeting a few days later[50]. Consequently, the Committee seemed prepared to pursue the issue so far as they

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[46] As stated earlier, one of the responsibilities of the Commission was to protect the navigability of the river, achieved in part through the maintenance of at least ten feet of water between Gloucester and Stourport at every season, with which the construction of a hydro-electric station at Diglis Weir could potentially have interfered.
[47] *Ibid.* footnote 45
[48] Whether this was one of the original fifteen tenders is unknown due to an incomplete archive
[49] 17th June 1892, Minutes of the Watch and Lighting Committee 1889-1893, Worcester City Archive, WRO.
[50] *Ibid.* 21st June 1892, Minutes of the Watch and Lighting Committee 1889-1893, Worcester City. An eminent engineer, Preece was undoubtedly familiar with the industry's enthusiasm for water power, hence his recommendation to Worcester County Council.

could avoid difficulties with the Severn Commissioners and the Severn Conservators[51].

Despite the Council's reassurances, the objections of the Severn Conservators and the Severn Commissioners ultimately resulted in the relocation of the project. In an attempt to resolve the ensuing conflict regarding the use of Diglis Weir, a conference had been held between the Brush Company's engineer, the proposed turbine manufacturer's representative, the Severn Commissioners Engineer, the City Surveyor and a representative of the Severn Conservators by the name of John Willis Bund, who also happened to be the group's Chairman. On behalf of the Severn Conservators Willis Bund stated they would offer no opposition to the proposal to use Diglis Weir. However, the Severn Commissioners Engineer could offer no such assurance as regards the Commissioners. The exact nature of their opposition seemed rooted in the water levels flowing over the weir. A report of the Committee meeting of the Severn Commissioners held on 17th September stated that it could not sanction any scheme which proposed to lower the water flowing over Diglis Weir to a depth of less than six inches and any consent that the Commissioners would give to use the water above this level must be subject to their right to utilise this water at any time.

The extent to which these potential conflicts would ultimately have obstructed the development of the hydro-electric station can only be conjectured as the conflict was unexpectedly diverted by the proposal of an alternative location. Recognising

[51] The Severn Commissioners and the Severn Conservators had also requested that the Brush Company send further information regarding the need for protection of the inlet and outlet of the new channel to prevent interference with fishing activities to which the Brush Company obliged sending detailed drawings of the turbines. However, the exact configuration of the sluices proved to be a bone of contention for the Severn Commissioners and further objections were submitted.

the opportunity to resolve the deadlock but also for financial gain, at the aforementioned conference Willis Bund, who in addition to his role as Chairman of the Severn Conservators was also a local landowner and magistrate, proposed an alternative location of which he was the proprietor, at Powick Mills[52]. The disused mills were situated on a small island at the confluence of the River Teme and its smaller tributary Laugherne Brook (see figure 5.3.1). Although the Teme was a tributary of the Severn, Ordnance Survey data reveals that it was not significantly smaller than the Severn itself and as later investigations revealed had the potential to yield significant power. The use of Powick Mills was from Willis Bund's perspective quite an ingenious suggestion as it served both the barrister's *public* and *private* interests[53]. Not only would it negate any perceived interference with the movement of Salmon on the Severn at Diglis Weir, which in his position as Chairman of the Severn Fishery Board he had a duty to protect, it would also promise to net the landowner a sizeable income through the sale or lease of land, which at that point lay vacant and the mills disused[54]. Neither, as it later transpired, would this arrangement compromise his personal fishing rights on the River Teme at Powick.

[52] 6th October 1892, Minutes of the Watch and Lighting Committee 1889-1893, Worcester City

[53] Such was Willis Bund's inclination for the sport, he wrote a contribution on Angling to the Victoria History of the county (see Willis-Bund (1906))

[54] The mills are listed in the 1892 Kelly Directory for Worcestershire as the premises of "Russell, Miller" so were in recent use although evidently unoccupied at the time.

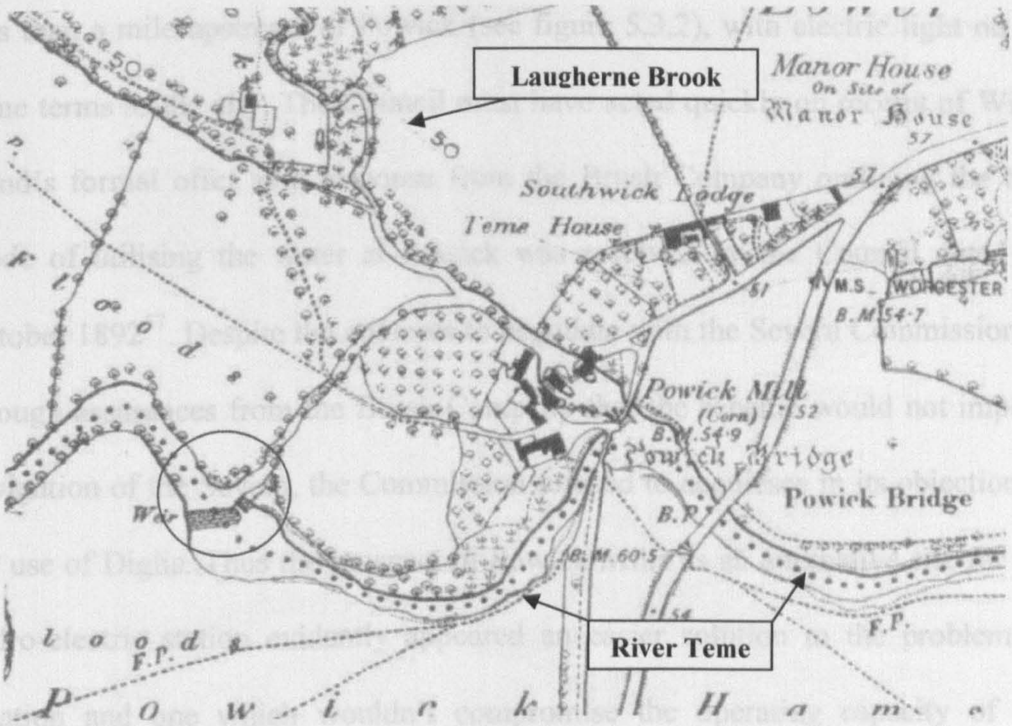

Figure 5.3.1 Powick Mills showing the River Teme, its tributary Laugherne Brook and Powick Weir
Source: First Edition OS Map (1886)

Willis Bunds proposition was later formalised in a letter to the Council[55]. In this correspondence Willis Bund offered to lease Powick Mills for a period of ninety-nine years with a covenant for renewal at £160 per annum. The lease included a reserve on the rights to fishing and the use of eel traps at the site, something which would later interfere with this otherwise cordial relationship (see 5.5). Alternatively he offered the land for sale for £5000 with the same reservations, Willis Bund in either case maintaining the weir, granting a right of way over the property from the bridge and the yard and the right to navigate the Teme if such navigation was not public[56]. The offer was made on the assumption that the Council would supply him and his tenants at Wick Episcopi, his private residence

[55] 11th August 1892, Minutes of the Watch and Lighting Committee 1889-1893, Worcester City
[56] Private plans to make parts of the Teme navigable were prepared in 1635-6 by local landowner William Sandys of Fladbury but were never implemented (Vellacott 1906; Paget-Tomlinson 1993).

less than a mile upstream of Powick (see figure 5.3.2), with electric light on the same terms as the city. The Council must have acted quickly on receipt of Willis Bund's formal offer as a response from the Brush Company outlining the best mode of utilising the water at Powick was received by the Council dated 5th October 1892[57]. Despite the attempts to negotiate with the Severn Commissioners through assurances from the Brush Company that the scheme would not impede navigation of the Severn, the Commission refused to acquiesce in its objection to the use of Diglis. Thus the prospect of Powick Mills as an alternative site for the hydro-electric station evidently appeared an easier solution to the problem of location and one which wouldn't compromise the operating capacity of the station. The Committee were of the opinion that the proposal at Diglis should be abandoned and that the site at Powick should be granted serious consideration.

[57] The particulars of this letter were not stated in the Committee minutes. The Company later contacted the Council to advise of an increase in construction costs to £22209 for operating plant complete to the aggregate capacity of 400,000 watts, an effective water power of 486Hp. The use of the Teme would not therefore threaten to compromise the operating capacity of the station.

Figure 5.3.2 Location of Wick Episcopi in relation to Powick Mills
Source: First Edition OS Map (1886)

For final confirmation of the feasibility of operating a hydro-electric station at Powick, the City Engineer, Mr Purchas, was directed to report on the power likely to be available at the site and the navigability of the River Teme, on which Purchas reported that the Teme could be relied upon to yield 850,000 effective horse power hours a year. Together with a report submitted to the Watch and Lighting Committee by its engineer Thomas Caink, based on this information it was decided to purchase the land at Powick Mills and adopt the revised scheme submitted by the Brush Company.

At this juncture it is pertinent to reflect on the relocation of the proposed hydro-electric station, primarily on the way in which it illustrates the shifting power between the traditional ruling elite and the competing municipal powers of the Local Authority in the late Victorian age. The records reveal that in addition to

Powick other alternative locations had been investigated[58], thereby demonstrating the political leverage of such groups, which were predominantly populated by the traditional landed ruling elites. In the late Victorian period the growth of the municipality and its increasing importance in terms of civic governance worked to shift decision-making power from the traditional landowning aristocracy to the Local Authority through parliamentary measures such as the 1835 Municipal Reform Act and the 1875 Municipal Corporations Act (Fraser 1976). The result was a constant state of potential conflict which, as illustrated here, required delicate negotiation.

The state of class relations in Worcestershire in the late-nineteenth century is illustrated by a local press report of the opening ceremony of the hydro-electric station. The article remarked that "The presence and words of Lord Coventry, Lord Beauchamp and other visitors from different parts of the shire, manifested the cordiality of relations between city and county"[59]. That the local press commented on this aspect of socio-political county life is thereby suggestive of a history of discord between the emerging ruling economic classes who derived power through their elevation into municipal governance (Fraser 1998) and who largely resided in the city of Worcester and the traditional ruling elites who resided in the rural environs of the county. No doubt a degree of disgruntlement existed on behalf of the traditional ruling elites with regard to the newly emerging power and control of the local Corporation which threatened and diminished the influence of traditional ruling elites in the county. In a study of Victorian urban politics, Derek Fraser states that since the Municipal Reform Act of 1835 the

[58] 11th November 1892, Minutes of the Watch and Lighting Committee 1889-1893, Worcester City
[59] *Worcester Daily Times* 12th October 1894

municipal council had increasingly become the forum for power struggles between the traditional Tory-Anglican establishment and the new Liberal-Dissenting economic elite (Fraser 1976). However, despite this shift, the power of groups such as the Severn Commission a Government board administrated by the traditional Tory landowning elite is evidence of the enduring power of traditional ruling landowning classes to influence such civic decision-making. This is further illustrated by the influence of Willis Bund whose landowning position granted him the power to virtually dictate the location of the station. Although his personal and public interests were not threatened by the original location his landowning interests enabled him to capitalise on the difficulties posed to the Council by the location of the hydro-electric station at Diglis.

The decision to use Powick Mills, like hydro-electric stations before it, also exemplifies the Victorian inclination for industrial re-use discussed in chapter 4, itself an illustration of the Victorian sensibility for both efficiency and thrift. During the late-nineteenth century, the re-industrialisation of abandoned mills, clearly connected to these ideas in terms of *economy*, however as an example of civic improvement this practice necessarily extended to the Victorian *environmental* aesthetic which as a corollary to ideas of efficiency also drew on the idea of 'not letting things go to waste'.

Returning to the development of Worcester's hydro-electric station, "mills, cottages and premises situate at Powick, Worcester" were purchased from Willis

Bund early the following year by the Council for £5000[60]. In addition to the aforementioned premises, the sale included three water mills, three water wheels, six cottages, warehouses, buildings, yard, and gardens adjoining the mills shown here in figure 5.3.3, which shows the original plan of the site[61]. Figure 5.3.4 demonstrates the layout of the building, whilst figures 5.3.5 and 5.3.6 show the front elevation of the boiler house and view of the tail race respectively and subsequently the scale and nature of the buildings.

The sale came with several conditions mainly relating to the fishing rights attached to the site, a practice which remains an integral activity along the Teme around Powick Mills. As the second specification of the agreement, the vendor reserved "the exclusive rights of fishing and also of placing fixed nets or engines for taking eels in the portion of the river Teme situate between the south east side of the said mills and the said old Powick Bridge subject to the condition that he should not thereby raise the level of the water in the said portion of the said river above the natural level thereof". This was followed by a third specification stating that "should the purchaser wish to widen the banks of the river or the channel or that of Laugherne Brook or the channel connecting them or to the use of the

[60] Agreement of sale and purchase of mills, cottages and premises situate at Powick, Worcester, 24th February 1893, CAB 21 Box 1

[61] A further requisition of land from Sir Harry Foley Vernon several months later on 8th September 1893 referred to only as "at Powick Bridge" suggests more land and property was required in order for the Council's to carry out its proposed plans for the hydro-electricity station. Land owned by Vernon is demarcated on the original plan of the site included in the sale (see figure 5.3.3). Vernon was a local landowner who represented Worcestershire in Parliament for some years. He was created a baronet in 1885 ('Parishes: Hanbury', *A History of the County of Worcester: volume 3* (1913), pp. 372-80. http://www.british-history.ac.uk/report.asp?compid=43139. Accessed 03/07/07). The Council had previously attempted to acquire land owned by the Great Western Railway 'near Croft Road'. A response was received from the company stating that they would sell subject to the approval of the Charity Commissioners although no explanation is stated. However, as no further mention of this is made in the committee books, it seems the proposal was subsequently abandoned. Given that the land owned by the Great Railway was not referred to further, it is possible that this site was purchased instead (Minutes of the Watch and Lighting Committee 1889-1893, Worcester City).

whole water power thereof the vendor will allow it if it does not exceed half an acre in total. Otherwise compensation will be paid to the vendor to be fixed by arbitration".

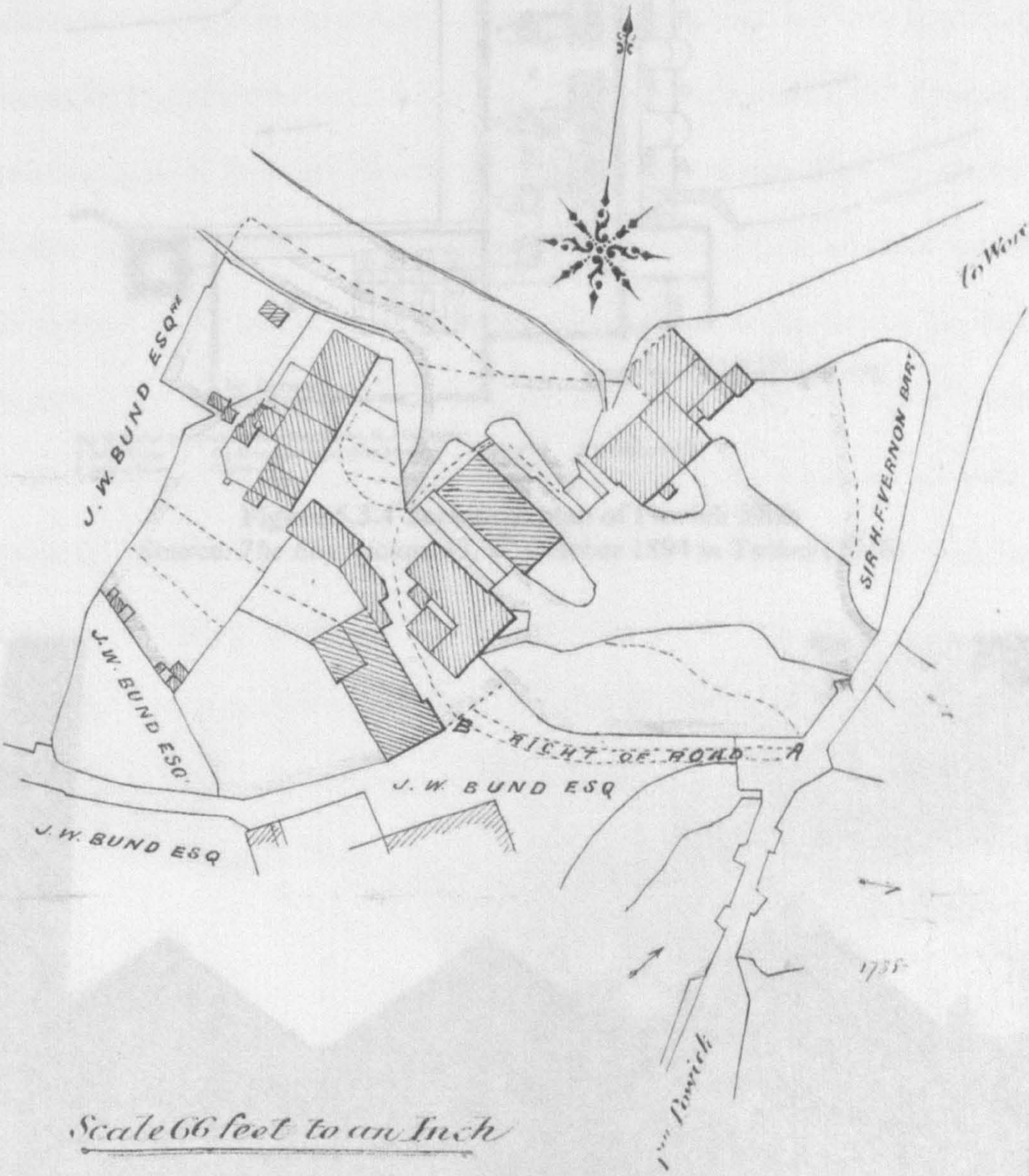

Figure 5.3.3 Plan of the site of Powick Mills
Source: Agreement of sale and purchase of mills, cottages and premises situate at Powick[62]

[62] CAB 21 Box 1, Worcester City

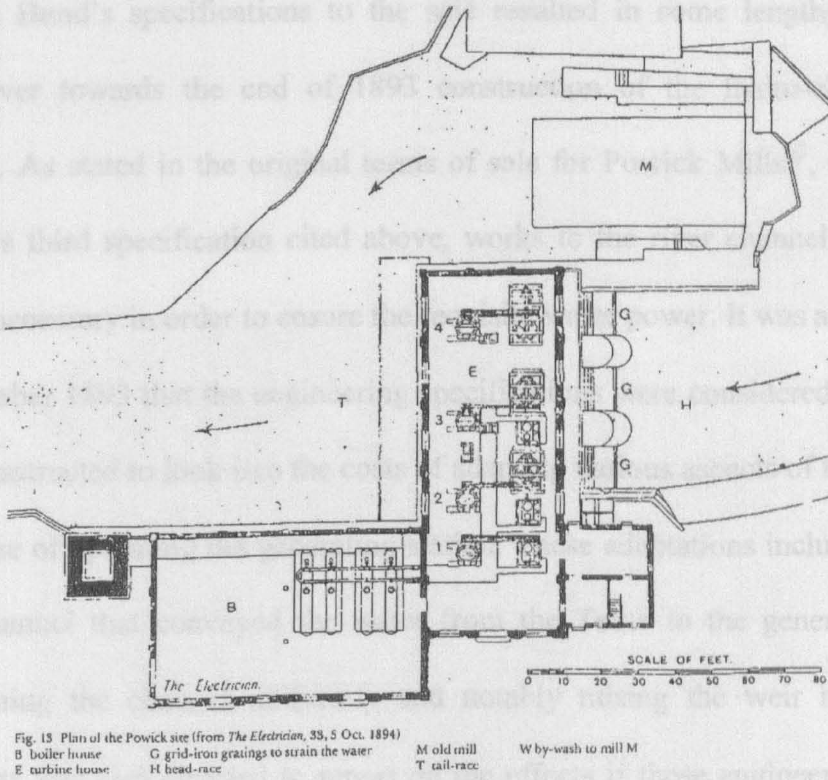

Figure 5.3.4 Technical plan of Powick Mills
Source: *The Electrician*, 33, 5th October 1894 in Tucker (1976)

Figure 5.3.5 The front elevation of Powick Mills
Source: Author's photograph

Willis Bund's specifications to the sale resulted in some lengthy negotiation. However towards the end of 1893 construction of the hydro-electric station began. As stated in the original terms of sale for Powick Mills[63], despite Willis Bund's third specification cited above, works to the river channel and the weir were necessary in order to ensure the requisite water power. It was at this stage, in December 1893 that the engineering specifications were considered. Purchas had been instructed to look into the costs of adapting various aspects of the site for the purpose of operating the generating station. These adaptations included widening the channel that conveyed the water from the Teme to the generating station, deepening the channel uniformly and notably raising the weir by 18 inches. Purchas was also directed to report on the effects if these engineering works on adjoining land[64]. Over the course of 1894 the amendments were completed. However, the latter adjustment which involved the raising of the weir was to become a great source of tribulation to the Council ultimately resulting in a High Court action. However these events did not transpire until after the opening of the station in the autumn of 1894.

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[63] Agreement of sale and purchase of mills, cottages and premises situate at Powick, Worcester, 24th February 1893, CAB 21 Box 1.
[64] The extent of 'adjoining land' which might be affected by the modifications was unspecified in the Committee minutes.

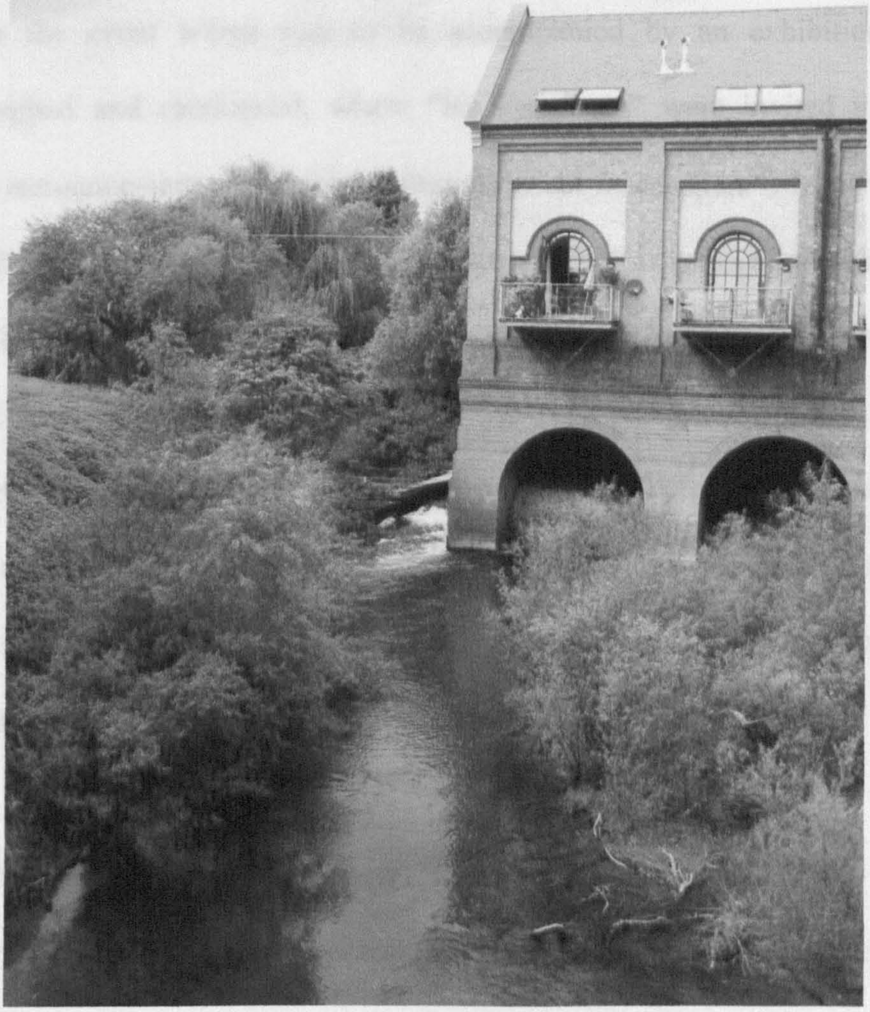

Figure 5.3.6 The tail race at Powick Mills
Source: Author's photograph

5.4 Hydro-electricity, Municipal Socialism and Localism: Civic Pride in Worcester

In the tradition of late-Victorian municipal governance, Worcester hydro-electric station was opened by grand ceremony on 11th October 1894. The function included a formal luncheon for three hundred held at the Guildhall. Invited guests included local dignitaries such as Lord Beauchamp, Lord Coventry and a host of eminent guest speakers[65]. The opening of the station was anticipated as such a grand affair that an Electrical Exhibition Sub-Committee had been appointed to organise the event which was to be accompanied by an exhibition, to be photographed and catalogued, where "leading firms" were invited to exhibit through announcements in all the leading electrical newspapers[66]. More than just the celebration of Worcester's first electricity station this was an opportunity to explore and promote the wider electrical lighting trade, thereby demonstrating the level of intrigue in the new industry but also its rapid growth during the late-nineteenth century (see Byatt 1979). The anticipated importance of the hydro-electric undertaking to the Council's municipal activities necessitated a greater level of attention and on its opening responsibility for the operation shifted to the newly appointed Electricity Committee.

In addition to celebrating the new electric lighting provision, the opening ceremony was an opportunity to praise the work of the Council. Its efforts in civic improvement served to elevate the Corporation as a leader in civic governance. The introduction of hydro-electricity provided two aspects through which this was considered. Firstly through the introduction of electric light: The local press reported: "We have heard a great deal about the light of the future. More and more certainly it is hailed as the light of the present. Electricity will swiftly and

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[65] *Worcester Daily Times*, 12th October 1894. Lord Coventry was the tenant of Croome Park which lies south of Worcester. The estate boasts the first complete landscape park designed by Capability Brown (source: www.nationaltrust.org, accessed 10/11/06). His invitation to the event not only reflected his social position in the county of Worcester but may also been an opportunity to further appease the local dignitary due to the need for recent assurances over the installation (see section 5.5).

[66] 6th July 1894; 17th July 1894, Electricity Committee Minute books, Worcester City. Despite the stated intention of the Council to document the exhibition no archival record of this document has been located.

surely advance"[67]. Not only was electric lighting considered superior to gas in its illumination and convenience of use, as discussed in chapter 4, electricity was considered as a symbol of modernity and progress. Through its endeavours in electric light, Worcester City Council was thus positioned as a pioneering municipal authority. How the Corporation had brought electric light to Worcester was also considered worthy of merit. For Worcester the use of water-power was also an aspect upon which it could further its civic reputation. The *Berrow's Worcester Journal* commented that

> there is striking distinction of the city's undertaking, because we are able to boast of the city's first extensive use of water power, and the plan so sagaciously proposed and so well executed is therefore regarded with wide and deep interest[68].

The Council's hydro-electric installation was used as a means not only to differentiate the city from other urban centres, but also from other local authorities as both its introduction of electric light and novel use of water-power were invoked to elevate the Corporation's civic reputation above that of other towns as a progressive municipality. The *Worcester Daily Times* reported that "Such an achievement afforded an example which opened out a vista of progress on a new path, for many towns in England". Not only was Worcester Council differentiating itself from other towns it was also setting the example and appointing itself as a leader in civic progress; "as one of the most advanced towns in the country" on the basis of its electricity endeavour and provision[69].

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[67] *Worcester Daily Times*, 12th October 1894.
[68] *Ibid.*
[69] *Ibid.*

The originality of Worcester City Council in its use of water-power did not go unnoticed by the more informed amongst the audience. One of whom was guest speaker Sir Douglas Galton, a notable nineteenth century engineer within the fields of sanitation and public health who resided locally[70]. In his speech, Galton, whose "scientific attainments [gave] to his eulogy a weight which [caused] it to be received with great respect and lively gratification" described the installation as "the finest in the country". For Galton "Worcester stood in the proud position of being the first town which had utilized to any considerable extent the natural conditions which lay ready to its hand for the generation of electricity". Godalming, Keswick and Lynton were each recognised for their water powered electricity generating schemes but Galton, like Tucker (1976) after him, placed Worcester above these efforts due to its size and complexity. The fact that the turbines would require no extra expenditure for fuel due to the free availability of the naturally flowing waters was considered "an enormous advantage". The ability to supply electricity cheaply was also considered "a great achievement"[71].

The new facility was evidently considered an impressive achievement in which the Council could take enormous civic pride; one which contributed to the wider achievements of the Corporation. The local press reported that

> The introduction of the electric light adds a very bright page to the records of a memorable Mayoralty, and enhances the pride of the citizens in that Excellence of material possession which is worthy of the city's long and rich tradition[72].

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[70] Source: Oxford Dictionary of National Biography http://www.oxforddnb.com/view/article/10317 (accessed 24/9/06).
[71] *Worcester Daily Times*, 12th October 1894
[72] *Berrow's Worcester Journal*, 13th October 1894

In particular the Mayor, George R. Williamson was highly praised for his "unstinting commitment" to the city, his "abundant energy and discretion" and how he had graced his office with "magnanimous hospitalities" to the city[73]. Williamson was clearly a politically ambitious Councillor. He was also politically astute: Williamson had used his position as Mayor to demonstrate his abilities in governance and leadership by implementing one of the most coveted facilities in Victorian urban Britain in a novel and progressive way. The opportunity for self-promotion that the new facility afforded was not lost on either Williamson or the City Council.

Not only was the new electricity works a source of great pride it was also a source of great profit. In its report on the opening of the electricity station the *Worcester Daily Times* reported, "The citizens were assured, again and again, that in the electric light and power works, they have a possession of which they should well be proud, and from which they should soon derive material profit"[74]. Furthermore, the installation was described as "a boon to a rich man, of incalculable benefit to the tradesman and the artisan, and to the labouring man"[75]. The electric light, as demonstrated at Blockley, was self-consciously promoted as an agent of economic regeneration. Its role in late-Victorian civic improvement was therefore twofold; firstly as an innovative, modern form of lighting, but also as a facility with the ability to attract new industry which might subsequently work to regenerate the local economy, which the pages of the local press suggest had been in a depressed state for some time[76]. The hydro-electric scheme was

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[73] *Ibid.*
[74] *Worcester Daily Times*, 12th October 1894
[75] *Ibid.*
[76] *Berrow's Worcester Journal*, 13th October 1894

seen as a venture that could address this issue. Public bodies were praised by the local press as "true economists while they continue to spend on public works", the article adding that "When depression begins to disappear there should be general readiness at once to take full advantage of the better circumstances, and the electric light is shining proof of the determination that Worcester shall not lose ground, but be among the communities that steadily progress in commercial and other ways"[77]. Not only was the *availability* of electric light promoted, the *cost* of the provision was also emphasised to attract new business which demonstrates the ongoing debate over the comparative costs of both gas and electricity and of water and steam-power, the motive power of water often prevailing over both gas and steam-powered electricity (see for example Grierson 1881).

The installation was presented to the citizens of Worcester (by Mayor Williamson) as a co-operative endeavour for the whole of the city and its citizens, one which should be the responsibility of the City Council. In his address to the assembled audience at the opening ceremony of the station Williamson argued that,

> It has often been contended that the supply of light, as of that other prime necessary, water, should be in public hands; and when electric lighting schemes were being promoted in so many directions the Corporation of Worcester could not themselves be inactive and at the same time impede competitive effort. The choice had to be made and the decision was a practical endorsement of the view that such

[77] *Ibid.*

a requisite should be furnished by the representatives of the ratepayers, controlling the source, the price, and every arrangement[78].

Electric power, in addition to water, in Victorian civic governance was considered a collective good; therefore as Worcester's civic representative and custodian, it was entirely acceptable that it should be in the hands of the public body. In this respect, in its provision of hydro-electricity, Worcester City Council conformed to the model of municipal socialism outlined by Fraser (1976). As far as profit was considered, any revenue made by the City would be returned to ratepayers through a reduction in rates. It was therefore in the interests of the citizens to adopt the service over gas, not least because it was implicitly stated that a loss would result in the opposite measure. In his speech, Williamson had reassured the audience that the Corporation had always been concerned with doing "the greatest good for the public at the least possible expense"[79]. As ever, cost-efficiency was decidedly a factor, one that citizens should recognise through adopting the supply as soon as was affordable. In this respect it was posited as the *collective responsibility* of the citizens of Worcester to patronise the provision to ensure a buoyant local economy.

Reflecting on this commentary, running through these expressions of civic pride is a strong sense of what might be described as *localism*. The hydro-electric installation was promoted to the citizen's of Worcester as an improvement *by* the City *for* the city. Although ideas of localism later became associated with

[78] *Berrow's Worcester Journal*, 13th October 1894
[79] *Ibid.*

environmentalism through post-war discourses of energy[80], the Victorian localist sensibility, at least in this context, connected to those of *economy*. The use of a local resource to power the installation, one that was naturally renewing, would reduce costs; savings that could be passed on to the consumer and subsequently re-injected to the local economy.

To interrogate these expressions further, despite primary considerations of economy, the Victorian perspective was not entirely devoid of ecological thought. As considered in chapter 2, at the end of the nineteenth century discourses of resource conservation were beginning to emerge. By the closing decades of the century, the supply of coal was already known to be exhaustible[81] and alternatives to this had been considered within engineering spheres. In his speech at the opening ceremony, in praising the Council's efforts in hydro-electricity, Douglas Galton expressed his sentiments on the timely use water-power, which the Worcester Daily Times paraphrased thus:

> They had talked for years on what they would do when the coal supply gave out, and the charter of incorporations of the Institution of Civil Engineers enjoined members to employ forces of nature for the use of man. Coal had come to them so easily that they had gone on using coal and improving steam engines without thinking of other sources of supply which nature afforded. Electricity had come to their aid for the transmission of power hitherto stored up in the rivers[82].

[80] See for example Schumacher (1973); Seymour (1976). These ideas are explored in greater detail in Part III.
[81] See for example Mackinder (1902)
[82] *Worcester Daily Times*, 12th October 1894

Not only does Galton recognise the latent energy of water, he also cites the development of electricity as the single factor in bringing about its exploitation. In his recognition of the finite nature of coal supplies, Galton was not the only individual to be demonstrating such an 'environmental' sensibility. In a display of environmental localism, somewhat ahead of his time, fellow engineer Thomas Grierson clearly without knowledge of the historical significance of his words had discussed the value of a nation dependent on the environmental resources available to it for the production of power. In reference to electricity production in Ireland, Grierson suggested that like France,

> where coal is scarce but water power is plentiful, there would be nothing to prevent the utilisation of the latter for a great many industrial purposes, much less for the driving of dynamo-electro machines ... we must surely censure ourselves for our want of enterprise in allowing this stupendous amount of energy to run uselessly to waste (Grierson 1881: 106).

For both Galton and Grierson, although the finite nature of natural resources was recognised, at this historical point, reflective of the Victorian sensibility for thrift expressed through ideas about *not letting things go to waste*, the consequences of this were primarily seen as a problem only in terms of industrial and economic progress; in these two examples at least, natural resources were there for the want of humankind. Despite this, it is significant that the natural energy harnessed within the rhythms of the natural world was starting to be recognised, at least by Engineers such as Galton and Grierson but soon after also by eminent Geographers such as Halford Mackinder as demonstrated at the outset of the thesis (see Mackinder 1902). The Victorian environmental vision therefore extended beyond ideas of aesthetic efficiency to those of conservationism, a tenet that characterised environmentalism until the post-war period[83].

5.5 Water as a Contested Resource II: Competing Claims to the River Teme

Despite the Council's pride in the installation, it would seem that their celebrations were somewhat premature. The initial operating period of the hydro-electric station was beleaguered with difficulty; complications that were founded in the role of rivers as a resource for a host of competing interests in late-Victorian England. To illustrate the multifunctional nature and hence the importance of water resources during the nineteenth century, not only was the power of water harnessed in rivers used as a motive power by watermills for a multitude of industrial and manufacturing activities, but as demonstrated earlier, rivers also served as important transport routes as well as being an important resource for agricultural and fishery interests[84]. Rivers were therefore a vital and contested resource, a situation to which hydro-electricity was to increasingly contribute.

In Worcester, the water resources of primarily the River Teme, but also the River Severn as a result of activities undertaken on the Teme, one of its major tributaries, corresponded to this model of Victorian river functionality. In December 1893, having secured premises for the scheme attention turned to the

[83] See chapter 6
[84] Illustrated by the appointment of parliamentary boards such as the Severn Commission and the Severn Fishery Board.

condition of the works in preparation for the opening of the station. As a result of damage caused to the weir by recent floods, as stated earlier the City Engineer Thomas Caink was directed to report on the cost of raising the weir by 18 inches and its effect on the adjoining land[85]. After a detailed inspection of the works, Caink reported that the crest of the weir was very uneven by a difference of twenty-four inches between the two ends[86]. It was agreed that the weir should be levelled and raised in preparation for the operation of the hydro-electric works. However, somewhat short-sightedly, despite having instructed Caink to consider the effects of the modifications on the 'adjoining land' the Council did not foresee the implications of raising the weir, which it would transpire, would be both extensive and detrimental.

The potential impacts of the amendments to the weir to agricultural interests on both the Severn and the Teme were however anticipated prior to completion of the works or operation of the hydro-electric provision. Seemingly unprovoked, ever mindful of its rights to the waterways, in August 1894 the Severn Conservators threatened to take legal proceedings should the repairs to the weir contravene the 46th Section of the 1873 Salmon Fishery Act regarding the obstruction to the passage of salmon. With similar concerns, having retained extensive fishing rights to the weir, Willis Bund brought about his own petition concerning water levels over the fish pass at Powick. Correspondence was also received from Lord Coventry's agent at the Croome Estate expressing apprehension about the work at the weir and its potential impact on agricultural

[85] 20th April 1894, Minutes of the Watch and Lighting Committee, Worcester City
[86] 4th May 1894, Extracts from the Minutes of the Council of the City of Worcester, the Watch Committee and the Electricity Committee and their sub Committees relating to Powick Weir, Worcester City

land owned by the Estate: reduced levels of water below the weir would have enabled cattle to stray across the river from Powick Ham. There was also concern over the increased probability of the flooding of Lord Coventry's land adjoining the river[87]. Whether it was protocol for the local authority to notify interested parties of intended works is unclear, although no mention of such correspondence appears in the relevant committee records[88]. However, news of the proposed works to the weir could have easily spread to interested parties as a result of more informal social and political networks. The concerns of Willis Bund and the Severn Conservators over the impact on fish passes were (despite some lengthy negotiations with Willis Bund) satisfied with simple reassurances[89]. Similarly, those of Lord Coventry were subsequently allayed by an agreement that the floodgates would be drawn whenever there was the prospect of a flood and a fence erected to prevent cattle trespassing during low flows[90]. As it transpired the Council was able to uphold its reassurances and no injuries were suffered as a result of modifications made to the weir to either party. However, on completion of the works, further unforeseen complications were realised for which the Council was not able to offer such assurances.

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[87] Extensive agricultural lands owned by the Croome Estate were located both up- and downstream of Powick Weir.

[88] Extracts from the Minutes of the Council of the City of Worcester, the Watch Committee and the Electricity Committee and their sub Committees relating to Powick Weir, CAB Box 1

[89] Willis Bund's specific concerns related to his liability at the weir given that he had opted to retain certain rights and subsequently sought an indemnity against any legal proceedings as a result of work done to the weir. The Council finally replied that "I cannot think that you will press for [the indemnity] when you bear in mind that you have shown no ground on which you can be made liable for what the city council do in this matter" (*Ibid.* 10 July 1894). Although the Council managed to appease Willis Bund on this particular matter he continued to bring his interests to bear on the operation of the station throughout the decade (*Ibid.*).

[90] *Ibid.* 7th September 1894

In September 1894, after the weir had been raised (but prior to the operation of the station), a letter was received from the legal representative of Thomas Quarrell and John Powell, proprietors of Bransford Mills located approximately five miles upstream of Powick and their tenant Thomas White[91]. The letter stated that "the raising of this weir by the Corporation is prejudicial to my clients' property and that unless the weir be reduced to its previous level, my clients propose to institute legal proceedings for the recovery of damages and the injunction and such other relief as they may be entitled to"[92]. The exact nature of the problem experienced at Bransford Mills was outlined in further correspondence received from Quarrell and Powell's solicitor:

> I have ample evidence that for at least 40 years until the Corporation recently raised the weir, Bransford Mills could be worked when the head and tail water were at a certain mark, and that now when the head water is at the same mark the tail water is so much higher so that the wheels cannot work and consequently my clients the tenants are suffering damage for which they will require compensation and such other relief as they may be entitled to[93].

The injuries did not end there however, and further correspondence stated that the proprietors of Bransford Mills

> have suffered and are still suffering in respect of their meadow land at Upper Wick by the water being kept back by the weir and their land has much deteriorated in the

[91] Bransford Mills were operating as flour and clover mills (Extracts from the Minutes of the Council of the City of Worcester, the Watch Committee and the Electricity Committee and their sub Committees relating to Powick Weir, CAB Box 1, Worcester).
[92] *Ibid.* 8th November 1894
[93] *Ibid.*

last three months by the ditches being continually full of water a very different condition of things to that of the last 21 years; both these gentlemen intend to press their claims for damages with those of Mr White for loss in consequence of mills being stopped ... unless matters can be arranged amicably forthwith[94].

The increase in height of the weir had evidently caused river levels upstream to rise[95]. Not only did this increase the river's propensity to flood upstream of the weir, it also prevented the efficient working of the millwheel at Bransford, problems the Council had clearly not anticipated. Where the concerns of other parties had been relatively easily allayed, those of the proprietors of Bransford Mills were much less easily mitigated. For reasons unknown, for almost a year the Council prevaricated, dismissing Quarrell, Powell and White's claims and ultimately refusing to accept responsibility for the injuries caused at Bransford Mills. Even reports of consulting Engineer Charles Hawskley[96] commissioned by the Council in August 1895 which found a positive correlation between the work done to the weir and the effects witnessed at Bransford Mills in addition to an investigation by the City Engineer almost a year after the claimants' original complaint in September 1895 confirming that the level of the mill pool at Bransford Mills was considerably above that of the river, could not divert the Council's decision. Subsequently, in October 1895, after the opening of the hydro-electric station and after several threats to do so, legal proceedings were begun against the Council by the tenants of Bransford Mills. The writ cited the

[94] *Ibid.* 13th December 1894
[95] Ordnance Survey data states that the area immediately north of Bransford Mills was 'liable to floods', however the undisclosed location of the meadowlands in question means the influence of this factor cannot be measured against the impact of the Council's work to the weir (OS Map of Worcestershire, Sheet XXXIII, SW, Second Edition 1905).
[96] Hawksley (of T&C Hawksley) was a Canal Engineer and the son of eminent Victorian water engineer Thomas Hawksley who had earlier worked on the Council's drainage system (www.oxforddnb.com accessed 06/07/07).

flooding of the meadowlands occupied by the tenants of Bransford Mills which had "seriously lessened its yield" and the frequent drowning of the mills which regularly rendered the waterwheel inoperable[97].

At this point, a year into the operation of the scheme, and over a year into the case, both the Council records fall silent on the issue, aside from an untitled and anonymous document dated 14th March 1896 which appears to be notes on the case. The document commented: "An awkward case. There is no doubt that when the weir was first touched the engineer acted with greater zeal than discretion in raising the level undoubtedly above what it had probably ever been before"[98]. The notes continued to record that the Corporation had admitted this and that damages should be paid. Although no further records were found relating to the court action or its outcome, an entry in the minute books of the Electricity Committee implies that the weir was subsequently altered to its former level.

Despite the council's prevarication over the matter, evidence suggests it was ultimately legally required to return the structure to its former level, a ruling which eventuated after endless correspondence between the two parties and ultimately a lengthy court procedure. If this is compared to the immediate and willing response of the Council to the earlier concerns of Willis Bund, the Severn Conservators and Lord Coventry, the contrasting approaches to how the concerns of those with landed interests and those without were appeased again demonstrates the careful negotiation required between the traditional and

[97] Writ issued to the Corporation on 3 October 1895, Extracts from the Minutes of the Council of the City of Worcester, the Watch Committee and the Electricity Committee and their sub Committees relating to Powick Weir, CAB Box 1, Worcester City
[98] CAB Box 1, Worcester City

emerging ruling powers of the landed elite and the municipal authority, where those of the lower, unlanded economic classes were virtually dismissed.

The example of the High Court action between Worcester City Council and the proprietors of Bransford Mills in addition to the concerns raised by Willis Bund, the Severn Conservators and Lord Coventry, illustrates further the significance of rivers to both industrial and agricultural interests in late-Victorian England. These episodes in the history of Worcester's hydro-electric station serve not only to demonstrate the variation in the meaning of water resources in Victorian England but also the extent of competing claims, an aspect in which further industrial interests were to feature during the initial operating stages of the scheme.

During the early 1890s, the mill premises adjacent to Powick Mills were leased to the Worcester Porcelain Company. Despite earlier assurances in 1893 from both the turbine manufacturer and the Brush Company's engineer that the Porcelain's Company's extraction of water would not prohibitively interfere with the working of the hydro-electric station, by May 1896 the availability of water power had become a point of conflict between the two industrial interests[99]. In October of that year the Council initiated proceedings to try and regulate the use of water power between the two parties[100]. However, a year later, the Company's lease expired and the Council was able to take full advantage of the available water power at Powick, thus temporarily mitigating some of the problems encountered

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[99] 21st January 1893, Minutes of the Watch and lighting Committee 1889-1893, Worcester City
[100] A consultant engineer for the Council had reported that the Porcelain Company were using too much of the available water-power (*Ibid.* 5th October 1896).

by an unpredictable source[101]. However, despite this temporary resolution, problems of water power availability and reliability continued to plague the installation, ultimately, typical of nineteenth century hydro-electric supply, threatening its long-term viability.

5.6 Hydro-Electricity and Resource Availability

Concerns over the availability of water-power had initially been raised in June 1895 when a comparative review of steam and water power was undertaken[102]. The subsequent report showed an increased use of steam as a result of both flooding and low water levels. Over a period of 166 days water power had been used 101 days and steam power for 13 days with a combined usage on the remaining 52 days. The results of this review perhaps revealed a greater dependency on steam power than had initially been anticipated. The result was to secure a contract for the supply of coal from a local merchant[103].

The use of water-power was seemingly more problematic than initially anticipated. Coupled with competing industrial claims to the water-power from the Porcelain Company, in the December of 1896, concerns over the efficiency of the turbines were raised resulting in the Brush Company's engineer to raise the head of water by 2 feet[104]. A month later, an investigation by the consulting

[101] Later entries in the minute books of the Electricity Committee suggest however that at least some water rights were retained by the Porcelain Company as negotiations over the number of hours it used the water power were still ongoing between the Company and the Council until 1903 when the Council finally took over the complete lease of the mills (Minutes of the Electricity Committee 1894-1912, Worcester City).
[102] *Ibid.* 17th June 1895
[103] *Ibid.*
[104] *Ibid.* 7th December 1896

engineer W. H. Preece concluded that the turbines were only 60 per cent efficient and the present turbines were ordered to be replaced[105]. However, by the following July, adjustments were still being made to the turbines in an effort to improve efficiency[106]. Throughout these technical modifications, steam-power continued to be employed, and given that emergency supplies had to be ordered due to the exhaustion of the previous years' supply, presumably depended on quite considerably to ensure a constant supply[107]. Despite appeals to the Brush Company to assist in the matter, the Company replied that it had no responsibility in terms of the matter and the Council struggled on in an effort to improve the efficiency of the installation[108].

Problems highlighted by the increased dependence on steam, competing claims to the water power and turbine efficiency proved that the water-power of the Teme at Powick was, despite previous claims to the contrary, inadequate. Although the plant was initially able to supply 200Kw of electricity entirely by water power, from the onset of supply the installation had failed to meet expectations of the anticipated 400Kw operating capacity. Tucker (1976) suggests that initial calculations had been inaccurate as engineers at the plant had used maximum water power as a basis for planning which the author describes as 'absurd' (*ibid.*: 157). Tucker finds evidence reporting that the problems at the plant were compounded by unusually low river flows which contributed towards several "hydro-electrically unsuccessful" years (*Ibid.*: 158). However, drawing on annual rainfall records for Worcester and monthly records for Cheltenham (just over

[105] *Ibid.* 18th January 1897
[106] *Ibid.* 19th July 1897
[107] *Ibid.* 1st March 1897
[108] *Ibid.* 29th November 1897

twenty miles away) Tucker contests the reported 'drought' conditions and states that rainfall records are "quite sufficient to dispel the idea that 1895, 1896 and 1899 were abnormally dry" (*Ibid.*: 159). Instead he proposes that problems of water storage were responsible for the lack of success of the plant, as a reservoir, that he suggests would have addressed storage issues, was never built (Tucker 1976). Electricity Committee minutes demonstrate that the efficiency of Powick continued to be a concern into the early years of the twentieth century[109].

Problems of supply were also compounded by unanticipated demand. By the beginning of 1899 it became clear that the expansion of street lighting, private consumers and the introduction of a privately run electrically powered tram system had increased demand beyond initial expectations, for which, in February 1899 the new city engineer Mr Sutherland advised the construction of supplemental plant[110]. Several months later in July 1899 it was decided, on the expectation that the tramway would be municipalized in the near future, that the supply should be expanded[111]. Due to a lack of suitability between traction and alternating current through which the supply from Powick was conducted, it was considered undesirable to extend the station and a suitable site in the city was sought for an additional generating station[112]. Despite this decision, during the process of seeking out new premises a review of the operating efficiency of Powick had been requested to provide a "statement showing the total number of units that could have been generated by water at Powick Works during the years

[109] Minutes of the Electricity Committee 1894-1912, Worcester City
[110] *Ibid.* 20th February 1898, Minutes of the Electricity Committee, Worcester City
[111] On consideration of the extension of the electricity supply, the Streets Committee had been consulted as to "the provision that should be made in any future extensions of such plant, for the supply of current for purposes of traction in connection with the tramways" (*Ibid.* 20th February 1898).
[112] *Ibid.* 28th July 1898.

1898 and 1899 respectively with the present plant assuming there had been a full demand for the current during the entire year"[113]. By September it had been resolved unanimously by the Electricity Committee that it was "inexpedient to extend Powick Generating station". No explanation was recorded; nor were the results of the requested report. However the experience of using water-power (presumably in addition to the results of the report) was undoubtedly influential to this decision[114].

In locating a new site, despite the Council's experiences of using water-power, a supplemental site was proposed at Diglis (see figure 5). Although the particulars of the scheme are not detailed in the Electricity Committee minutes, the location of Diglis suggests the use of water-power had not been dismissed[115]. Several alternative locations were considered but in December 1901 a loan for £30450 was sanctioned for the construction of new plant at Hylton Road located closer to the centre of Worcester than Powick and close to the west bank of the Severn. Despite its proximity to a vast water resource it was decided that the station should be powered by steam. The experience of using water-power had presumably proved too problematic for the local authority. Not only was water-power a contested resource to which numerous interested parties could and did stake their claim, a situation which potentially compromised its availability, the unreliability of water-power rendered the operation too inefficient for the

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113 *Ibid.* 23rd April 1900; 1st June 1900

114 *Ibid.* 17th September 1900. Problems with water-power continued to thwart the station at Powick. A report from Sutherland, the City Engineer, found that the fall of the river between the turbine arches and the new bridge in the Malvern road was "very trifling, and not more than 4½ inches" (*Ibid.* 20th May 1901); In October 1901 Sutherland had reportedly spent £4 on pumping out floodwaters from the station (*Ibid.*).

115 *Ibid.* 22nd August 1900

municipal authority whose liberal agenda placed cost-efficiency for its shareholders as a priority.

5.7 Worcester Hydro-Electric Station in the Twentieth Century

In December 1902 the new plant at Hylton Road began supplying electricity to the Worcester Tramways and light Railways Company[116]. The Tramways Company had been notified over a year prior to this that electrical energy would be supplied to the company under its agreement with the Council from 1st December 1901[117]. In August of that year however the Company had written to the Council urging it to complete the plant sooner so that the new supply would be available in time for the Festival and Hop Fair in September and pressed them to construct their new lines in the centre of the town by the end of July[118]. The Festival and Hop Fair were civic opportunities through which the town of Worcester could demonstrate the electricity supply to its surrounding neighbours. Unfortunately this was not achieved and the supply to the Tramway Company began as previously agreed in the following December.

The electricity provision continued to expand over the decades, supplying more private consumers, the Tramway Company and other firms adopting the supply for driving works and factories (Shaw 1920). In 1903, to protect the municipal provision the Council took steps to specifically exempt the City of Worcester as an area of supply from the Shropshire Worcestershire and East Denbighshire

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[116] *Ibid.* 16th December 1902
[117] *Ibid.* 21st October 1901
[118] *Ibid.* 25th August 1902.

Power Bill[119], thereby protecting the Council's interests with regard to electricity undertaking and enabling it to continue extending its supply. By 1920, the official guide to the City boasted "All public buildings, the centre of the City and many thoroughfares are lighted solely by electricity" (Shaw 1920: 55). The Council had not only created for the city a modern and efficient facility, but also elevated the reputation of Worcester as a civic Authority.

Steam power at Powick was terminated somewhere between 1902 (Tucker 1976) and 1907 (Shaw 1920) and amassed at Hylton Road and Powick became a purely water-powered electricity supply station (Shaw 1920; Tucker 1976). By 1925 however, Tucker (*ibid.*) states that the station was contributing less than seven per cent of Worcester's electrical energy production. The plant was closed sometime between this date and 1928 when Ordnance Survey records show that a laundry was established at Powick Mills. Despite its difficulties with water supply, Worcester continued to operate the hydro-electric station at Powick with relative longevity.

To consider the civic legacy of the municipally operated scheme in Worcester, if its ultimate goal was the improvement of the city, it would seem the implementation of a local networked electricity supply, was both an industrial and municipal success. Not only was the city 'improved' through the electric lighting of public and private space, it also had the effect, in accordance with the Council's explicit aim, of attracting new industry, a practice in which the

[119] *Ibid.* 19th January 1903

electricity provision was cited as a primary incentive for industrial location. The 1920 city guide to Worcester stated that:

> The Electricity Department is in a position to supply cheap power, and the Railway Companies and the Severn Navigation Company have perfect facilities for the delivery of goods at low rates. Cheap building land for factories, etc., is available near the centre of the City and close to River Severn and the Birmingham and Worcester Canal (Shaw 1920: 56).

In the promotion of Worcester the electric lighting provision was a principal source of merit, in addition to other infrastructural properties afforded by the location of the city.

Throughout the chapter, it has been implicit that the use of water to power the electricity station at Worcester was incidental to the decision to implement the scheme. However by the early decades of the following century this feature, as it did by the centennial celebration at Godalming, had become a matter of peculiarity, a further aspect of Worcester's developmental history which warranted its promotion. Twenty-six years after the opening of the Worcester hydro-electric station, the handbook to the city described the installation as having

> features which are uncommon in British Municipal Electric Supply, in that the natural physical advantages of the River Teme enabled the Corporation to lay down an installation of electricity at Powick, some two miles from the City (Shaw 1920: 55).

Despite the incidental nature of the use of water-power to the Victorians, by the inter-war period, the use of water (rather than steam) to generate electricity was considered a point of historical interest. It was perhaps the case that the decline of traditional forms of motive power by the inter-war period rendered water an exceptional source of energy, especially for the generation of electricity[120]. Although hydro-electricity had developed on a large scale for industrial purposes in Wales and Scotland, by 1920 it was still a relatively uncommon form of electricity generation; despite concerns over dwindling reserves, coal continued to fuel the majority of domestic energy requirements (Simpson 1966; Supple 1987).

According to a commemorative publication to accompany the 1947 Worcester Civic Exhibition, a public electricity supply station continued to operate at Worcester until after the Second World War (City of Worcester 1947). The publication states that despite a meagre contribution to civic demand, it was a point of interest that an electricity supply station at Worcester was still operating (although admittedly this was from the Hylton Road station). In this commemorative edition, the emphasis is placed on the present electricity supply in Worcester which at that time was fuelled solely by coal from the Hylton Road station. Although the public electricity supply continued to be celebrated – "Mention should be made of the fact that every street in the City is lighted" (City of Worcester 1947: 36) - the historical significance of the Worcester's electricity station as the largest hydro-electric scheme for public supply in Britain prior to

[120] By the inter-war period the number of watermills had vastly declined due to continued agricultural decline and increased mechanisation of industrial and manufacturing practices causing them to fall into increasing neglect and disrepair. For accounts of the history of watermills in Britain see for example Finch (1933), Skilton (1947), Wilson (1956), Syson (1965), Wailes (1979).

the turn of the century, at that point lay latent, much as it does more than a century after its beginnings.

5.8 The Failure of Late Twentieth Century Hydro-Engineering Technology

As demonstrated in chapter 3, the introduction of hydro-electricity for public supply in late-nineteenth century Britain was an industrial development driven by Victorian technologic innovation and visions of civic improvement. Where the technological failings of other forms of lighting, specifically gas, had created a social and cultural demand for an improved version of artificial lighting, inventions in both electrical and hydro engineering culminated to bring about the development of electric lighting which vicariously brought about the transformation and evolution of industrial uses of water-power through late-Victorian environmental visions of civic improvement. These developments culminated in the introduction and demonstration of the first examples in Britain of what in the early twenty-first century is conceptualised as renewable energy.

By the late-nineteenth century, although the technology to create hydro-electricity had been developed, its introduction was ultimately facilitated by socio-political forces in the form of the Electric Lighting Act of 1882 which aimed to support the development of electric lighting technology. Through this mechanism, the technology was given the forum for experimentation and thus enhanced technological development. However, despite the success of public electric lighting systems, the introduction of public supply schemes was not without its difficulties: As witnessed, as far as *water*-powered electricity generation was concerned, problems of reliability and transmission were still being encountered even into its second decade of development.

It would appear that these early forays into hydro-electric power generation, although novel at the time, ultimately struggled due to inadequate and undeveloped water-power technology a problem which had obstructed a large number of proposals in their development stages[121]. Tucker concluded that the problem lay in the scale of the first hydro-electric schemes which he described as "hydraulically too unambitious" (1976: 162). To interpret this remark, it can be surmised that Tucker was of the opinion that larger rivers should have been utilised in order to guarantee the water-*power*. Although this was perhaps an engineering truth, it must be acknowledged that technological failure also occurred as a result of problems caused by ***too much*** water in times of flooding, thus suggesting instead that rather than too much or too little water, the technological failure lay in its adequate control.

It is not only with hindsight that the failures of water power were realised: the electrical engineers developing these installations quite often worked – to little avail – to rectify the problems *in situ*. However, for one particular commentator, an electrical engineer by the name of William Baxter who published an article in the trade journal *The Electrical Review* in 1895, the hindrance to the future

[121] In addition to the fifteen successful hydro-electric stations explored in the chapter, Tucker (1976) finds records for forty-five towns in Britain where between 1881 and 1894 hydro-electric stations were proposed but never adopted. Some were rejected in favour of steam power and in other cases demand for electricity rose so sharply that by the time some proposals had been approved, the generating capacity of the station was inadequate to meet the eventual demand and had to be relocated.

technological success of water power was founded in the position of water power as an experimental technology. Baxter (1895) argued that the way round this was to re-consider this status by fully embracing the technology to enable its further development and subsequently, greater technological success[122]. As far as Baxter was concerned, to view water-power engineering as experimental was a fallacy, instead contesting that the experimental phase of water-power technology development was over and it was time to capitalise on this knowledge which would soon occupy a major portion of electrical industry which he anticipated would become more important "than any other branch and the indications are that in the near future it will become as important as all the others combined" (*ibid.*: 173). Baxter predicted that "The development for some years to come will no doubt be in the direction of utilising large water power, but eventually as the cost of apparatus and the installation is reduced, smaller ones will be taken up, and perhaps the day is not far off when every farmer who has a power of 10 or more horse-power on his premises with harness it, and do with it the work now performed by animals or agricultural steam engines" (*ibid.*). Perhaps somewhat visionary, although he conceded that the technology was as yet inadequate, Baxter recognised the immense power available to be harnessed from water and it's potential as an energy source.

To consider Baxter's frustration at the delayed development of hydro-electric engineering in late-nineteenth century Britain, Pawson (1978) states that Britain was slow to move into the new fields which were to become important twentieth

[122] Despite the operation of nine hydro-electric stations in Britain Baxter (1895) states that the only successful example of this is at Niagara Falls, which had attracted world-wide attention, seemingly due to the magnitude of the scheme which, it was anticipated would be counted by the *millions* of horse-power.

century industries. This included electrical engineering, the branch of industry that fostered the development of hydro-electric power in the 1880s. Original material found for example in trade journals supports this supposition. Entries in journals such as *Electrical Engineering* and *The Electrician* convey an international focus as far as hydro-electric schemes are concerned, celebrating larger installations in for example North America and Europe over their smaller British counterparts. It is perhaps for this reason that the majority of the proposed hydro-electricity schemes in Britain were unsuccessful and rejected in the planning stages due to inadequate technological innovation (Tucker 1976). In his analysis of the processes of industrial change in the eighteenth and nineteenth centuries Gregory (1978) argues that technological innovation was only entertained where it appeared to open the door to greater profits. It is perhaps the case that the technological difficulties thus far encountered with water-power suffered from low investment as a result of economic short-sightedness and at this stage, despite Galton and Grierson's (1981) observations, a low appreciation of the environmental limitations of coal-use in terms of both resource availability and pollution.

This latter point connects to further observations about the use of water power in the late-Victorian period. What can be concluded is that its use was very much incidental to the wider issues of electricity generation. Although there are instances where the use of water is considered novel, its traditional use as an industrial power source meant that its novelty lay largely in its relation to the use of steam. Furthermore, this interest was often limited to a matter of technological curiosity at most rather than a significant aspect of a given installation. That is not to say that the source of power lacked discourse, but where this was debated for example in trade journals or council minutes, emphasis was placed on the relative cost of alternative power sources rather than the wider merits of alternatives *per se*.

Instead, the technological focus during this stage of hydro-electric development centred on the introduction of electric light; the aspect of electric engineering that constituted a material difference to the every day lives of those that witnessed it. As such, the interest in the use of water as a source of power only existed relationally to this branch of engineering at least where these things were primarily considered in trade journals such as *Engineering* and *The Electrician*. Other than Baxter (1895) and Grierson (1881) who themselves considered water power both from a technological standpoint and in relation to the field of electric light generation, the significance of the source of power was largely ignored. To cement the point, the significance of hydro-electric schemes in the nineteenth century was the wider introduction, through public supply, of electricity, specifically electric light.

Technological issues aside, the first hydro-electric schemes were also obstructed by political conflicts. By the late-nineteenth century being the only established source of artificial lighting, the gas companies had achieved a monopolistic status and although the gas lobby was never fully able to prevent the establishment of its more popular successor, attempts were made within local political arenas to obstruct the adoption of electric light. Furthermore, particularly the case of Worcester demonstrates how late-Victorian ideas of resource amenity were brought to bear on the introduction of hydro-electricity for public supply where competing claims to water resources worked to obstruct its installation through the clash of competing environmental interests.

As part of a wider Victorian agenda of civic improvement, the introduction of hydro-electricity corresponded to late-nineteenth century environmental visions. The practice of civic improvement in late-Victorian Britain drew on the ideals of efficiency, practicality, thrift, productivity and order, which extended to both the practical and the aesthetic and which were expressed through measures to address urban issues such as public health and sanitation, crime and delinquency and the general moral and physical betterment of society. The way the natural world was imagined corresponded with this vision through the sentiment of *not letting things go to waste*, a notion that was repeatedly invoked in the promotion of the employment of water-power for the production of electricity. However, more than this, the introduction of hydro-electricity was an example of late-Victorian engineers' belief in 'human progress' and the confidence of harnessing the otherwise idle natural resources (Buchanan 1989 in Owen 2006). The role of the natural environment within this process was recognised as important as the physical and psychological benefits of communion with the natural world became increasingly acknowledged and new ways of seeing the natural environment emerged over the second half of the nineteenth century. During this period, this emerging sensibility, part of a more liberal political agenda, was expressed through mechanisms such as the creation of urban parks and the protection of both open spaces and historic buildings[123].

The repeated examples of the re-use of abandoned industrial buildings and indeed the use of a naturally renewing resource itself was an example of the application of a moral and aesthetic vision of not letting things go to waste. In several of the schemes outlined above and especially at the installation at Worcester, it would seem that where possible engineers involved in electricity generation schemes used *what was already there*. Not only did this apply to locally available water power resources, but also to existing infrastructure through the *re*-use of abandoned mills and other industrial works. For most this was undoubtedly an economic decision which corresponded to the Victorian environmental aesthetic of efficiency and order: the use of water, a free source of energy, seen as otherwise 'going to waste' would reduce costs by negating the financial outlay for coal; the use of abandoned buildings would prevent their future dereliction. Furthermore their availability, as existing industrial remnants, was often influential to the development of hydro-electric power.

These late-Victorian engineering schemes also connect to modern environmental concerns through the idea of scale. The parameters of supply, as far as both engineers and Victorian civic governance were concerned was limited to the locale. At this point in time, engineering technology was yet to be sufficiently developed to be able to cope with large-scale supply, and as demonstrated in cases such as Godalming, where schemes attempted to supply wider locales,

[123] The Commons Preservation Society and the National Trust were established in 1865 and 1895 respectively.

technological failure prevented larger supply systems being realised. A further dimension to the idea of scale, connected to the scale of the area of supply, is that this determined the size of plant. Generating stations consisted of small-scale industrial works which were harmonious with their urban or rural environments, a concept that has featured heavily in modern day discourses of renewable energy in which large-scale generating works are considered incongruous within their predominantly rural environments.

The legacy of what were essentially experimental engineering feats is their contribution to the urban structural change of Britain. What can be said about these first examples of hydro-electricity is that through the employment of water power, the public supply of electricity was integral to the industrial and economic development of towns and cities in the late-nineteenth century, what might then and now be termed civic improvement and what with hindsight was the twentieth century modernisation of the British urban environment. However, the improvement of Britain's towns and cities was not limited to this physical change; the introduction of electricity also addressed the social and moral improvement of late-Victorian towns and cities in Britain. Not only did it afford the efficient and cheaper lighting of the streets, as demonstrated at Worcester, it also served to power the newly introduced electric tramways which offered an opportunity for substantial improvements in living and housing conditions; for a move away from the overcrowded houses and dark, cramped and unhealthy urban milieus of the middle of the century. The way these new manifestations of Victorian engineering worked to order landscape, was a further example of the role of engineering in the late twentieth century as an emerging elite knowledge in the constitution and production of landscape, as argued by Owen (2006) and alluded to by Revill (2007), discussed in chapter 2.

Despite Baxter's (1895) predictions regarding its growth, late-Victorian hydro-electric engineering for public supply schemes was an experimental technology and although advances were made, it remained as such through the closing years of the nineteenth century. However, the opening of the vast hydro-electric scheme for the Foyers Aluminium plant on the shores of Loch Ness in 1895 marked the introduction of hydro-electricity as an important source of power for industrial activity both in Scotland and Wales a tradition which continued into the early years of the twentieth century. It was perhaps these models of larger installations which stimulated the later manifestations of hydro-electricity for public supply in Britain: Despite the continued growth of many local ad-hoc hydro-electricity supply schemes during the early twentieth century, hydro-electricity failed to gain significance as a source for public supply until the inter-war period when, as documented by Payne (1988), it developed on a vast scale in the Scottish Highlands with individual stations far surpassing the scale and operating capacity of anything witnessed during the earliest phase of hydro-electricity development in England.

5.9 Conclusion: Symbolic Landscapes of Technology and Power I

The case of the Worcester hydro-electric station examined in this chapter has illustrated the challenges, both environmental, in terms of managing resource *availability* and socio-political, in terms of negotiating resource *access*, faced by late-nineteenth century electrical and civil engineers in attempting to establish hydro-electricity in Britain's burgeoning towns in the late nineteenth century and in doing so bring the new and highly coveted facility of electric lighting to the urban populace.

Through tracing the histories of the first hydro-electric and thus first *renewable energy* schemes for public electricity supply in Britain, more than the relative successes and failures of renewable energy technologies at this historical juncture, the case of late-nineteenth century hydro-electric development demonstrates the intimate relationship between landscape, technology and power as a symbol through which a new *modernising* sensibility could be expressed. A condition of the culmination of almost a century of technological development, the pre-eminence of the professional engineer through such socio-technological systems signified the emergence of technology as a new cultural authority and electrical engineering as a new modernising medium through which it was envisioned that society at the turn of the twentieth century could 'modernise', which, as discussed in chapter 2 was reflected in the construction of late-nineteenth century landscapes of power. Building on over a century of social and technological change, the introduction of electricity, significantly electric lighting, as examined by O'Dea (1958) and more significantly Schivelbusch (1988) ushered in a new technological era which facilitated a further material and conceptual change through which a cultural and technological transformation took place.

As a further symbol of 'modernisation', during this phase of socio-technological change, the ordering and control of landscape through attempts to harness the latent energy of water, signified the subjugation of nature to technology in its ability to foster industrial and economic progress and thus replace a declining agrarian social order, characterised by humankind's close bonds to nature and the land.

With these ideas in mind, Part III of the thesis considers engagements with small-scale renewable energy generation almost a century after the first hydro-electric schemes for public supply, demonstrating how meanings of landscape and technology in the context of renewable energy evolved and in a complete reversal of social and environmental values, sought to reject the ideals embraced in and embodied by late-Victorian hydro-electric development.

III

The Centre for Alternative Technology: Alternative Visions of Environment, Society and Technology

In examining historical discourses of renewable energy, the more recent past also bears relevance given both its connections to ideas of water, landscape and energy in the twentieth century and its significance to contemporary understandings of naturally renewing energy sources. Since the 1970s ideas of nature and energy have become synonymous with those of their *renewability* as sources of energy. As discussed in chapter 1, prior to this period the connection between natural sources of energy and ideas of renewability held little discursive power. However, from the early 1960s natural energy sources such as water, wind and solar began to be thought of in terms of their naturally renewing and therefore environmentally benign qualities, a perspective borne out of a unique cultural movement which exhibited new visions of environment, society and technology.

Part III explores this movement and the engagements with naturally renewing energy sources that it fostered through tracing the initial history of the institution and development of the Centre for Alternative Technology (CAT) in rural mid-Wales in the mid-1970s, one of a series of projects experimenting with the application of both alternative technologies and alternative communities in Britain during the decade. The Centre, located in a remote valley in mid-Wales was first established in 1973 by Gerard-Morgan Grenville, a restless and disaffected young entrepreneur keen to bridge the gap between the alternative and conventional worlds. Where other similar experimental projects were short-lived, CAT survived, succeeding in its objective of demonstrating self-sufficiency through the integration of alternative technologies, becoming an exemplary model in the pioneering of alternative ways of living in Britain. Self-consciously affiliated to the counter-cultural 'alternative' community, against wider social prejudices towards such groups, the Centre ultimately achieved credibility and succeeded in its bid for socio-political legitimacy.

Part III comprise two substantive chapters. The first, chapter 6, considers of the contextual history to the birth of CAT considering a distinct version of environmentalism that emerged in the post-war period which as a corollary to new ideas about the relationship between the natural and human world fostered new ideas of technology. The chapter continues by considering the personal biography of the founder of the project in relation to his specific environmental ideology and the institution of the Centre in its specific locale. Chapter 7 functions as a material (and largely chronological) history of the development of CAT in the early to late 1970s. Adopting a more thematic approach, the chapter considers the practical expression of alternative visions of technology and society at CAT as well as considering the legacy of the project to local and national political and cultural spheres.

6 Counter-Culture, Environmentalism and Alternative Technology

6.1 Alternative Visions, Alternative Technologies: Counter-Modern Environmentalism and Alternative Technology

In the post-war period an environmental movement emerged that was both mobilised and radicalised and, significantly, counter to wider conventional western culture. This movement in turn fostered the emergence of what is both contemporaneously and retrospectively described as the Alternative Technology movement, an active expression of the new environmentalism which sought new forms of primarily energy technologies that were both appropriate to the environments in which they were situated and benign in their effects on the social and natural worlds.

6.1.1 The Counter-Modern Environmental Movement: Environmentalism Re-Envisioned

Practical engagements with 'alternative' sources of energy from the 1970s built on the post-war organic movement's argument for 'natural' forms of energy production and the advocacy of 'appropriate' technology most notably by the economist E.F. Schumacher. Such ideas were borne out of an emerging ideology which critiqued the dominant structures of the post-war industrial economy and linked to an existing environmental sensibility that had emerged at the end of the previous century. The movement was therefore essentially reactive, but also reformist advocating a model of societal restructuring according to a unique ecological, holistic re-interpretation of the interaction between society and the natural world founded on the principles of Environmentalism.

Emerging in the early 1960s, the new environmental movement was a critique of post-war society and the dominant structures upon which it was founded. The austerity of the immediate post-war period had been replaced by the late 1950s by unparalleled and sustained economic growth and prosperity which fostered an escalating materialistic sensibility (Veldman 1994; Lowe and Goyder 1983; Pepper 1984; O'Riordan 1976; Dobson 1991). The increasing technocratisation of society in the twentieth century witnessed through an economic policy which advocated increasing and aggressive industrialism involving the commercial exploitation of the earth's natural resources was responsible for an increasingly socially and environmentally atomised and degraded world (Brown 1985). In this way post-war industrial society was implicit in creating the modern condition to which the new environmental sensibility was opposed. The new environmentalists sought to reject the prevailing societal condition and instead seek new environmentally and socially benign structures.

This re-worked post-war version of environmentalism drew on earlier expressions of the sensibility and thus reiterated the ecological sensibilities manifest in the ideologies of certain groups and individuals from the late nineteenth and early twentieth centuries who espoused ideas about rural preservation, nature conservation, the organic movement, localism and community. This extended as far back as the mid-late nineteenth century to the buildings preservation movement which had become formally established in the 1870s with the creation of the Society for the Protection of Ancient Buildings in 1877. The historical sentiments which defined the movement are considered by David Pepper in his comprehensive examination of *The Roots of Modern Environmentalism*:

> Intellectuals like Ruskin, Morris and Mills, who all founded environmental groups, rejected the optimism of economic liberalism and became pessimistic about the prospects for social and economic advancement through laissez-faire capitalism. They were equivocal towards industrialism and, like earlier romantics, saw it as destroying morality and social order, human health and values, and nature ... there was too a similar yearning for the 'organic' social bonds which were thought by people like William Morris to have characterised medieval communities (Pepper 1984: 17).

The ideals of late-nineteenth century environmentalists were therefore re-visited and reaffirmed a century later in what Pepper (*ibid.*) characterises as the 'modern environmental movement'. In a comprehensive trek through what she describes as the 'Greening of Britain', Meredith Veldman (1994) argues that the respective environmental sensibilities of the late-nineteenth and late-twentieth centuries were linked through a sentiment she posits as 'romantic protest', which she explains "sought to strengthen the bonds between humanity and the natural world, endeavoured to restore the ties between individual human beings and their histories, and struggled to rebuild community life and spirit in a society believed to be increasingly atomized" (Veldman 1994: 1). According to Veldman (*ibid.*), this sensibility found expression through different movements at different times throughout the twentieth century[1].

The technocratic age of the post-war period fostered two primary engagements with industrialism, upon a reaction to which much of the new environmental movement was founded. The events of the Second World War, and the subsequent era of technical optimism had fostered socially and environmentally harmful applications of science and technology, an area upon which modern society in the post-war period was founded. From the early 1960s people were awakening to the damage inflicted on the natural environment by human processes in which science and technology

[1] To consider the temporal emergence of the new environmentalism, commentators have argued that this new way of envisioning the world was a function of the post-war condition. This was reflected in the sustained period of economic growth in the late 1950s and again in the early 1970s, a requisite that Lowe and Goyder (1983) state is a condition for the resurgence in a wider collective expression of environmentalism when people were perhaps more inclined to react to highly materialistic values (Lowe and Goyder (1983) observe that forms of environmentalism also surfaced during the 1890s, and 1920s). The authors state that individual wealth was higher than ever in the period of economic growth following the Second World War (Lowe and Goyder 1983). Similarly, Veldman (1994), drawing on work by Samuel Hays (1987) on the history of environmentalism in the United States, cites the post-war affluence of the Western world as a pre-condition of the modern environmental movement which, she argues, contributed to expressions of eco-activism in two ways: firstly, post-war affluence which fostered post-war materialism, rested on environmentally destructive industrial expansion; secondly, Veldman (1994) argues that post-war affluence afforded eco-activism a constituency. This is illustrated through the comparative reactions to the publications of *The Living Soil* in 1943 and *Silent Spring* two decades later in 1962 when the latter had an arguably greater impact. The conditions of post-war society created a consumerist condition which Hays (1987) argues is a prerequisite for ecological concern; a form of, rather than a reaction to consumerism. Individuals demanded clean air and wilderness in the same way that they demanded consumer goods (*ibid.*). Secondly, Veldman cites the increasing availability of environmental data which lead to both heightened concern over the condition of the natural world and increased awareness of its connections to human health.

were almost singularly implicated. As one disciple of the new environmental movement explained:

> Before [the 1970s] the promises of Science, that was the nice story ... the optimistic post-war, great, new technology, bringing the new world, everything will be fine. So people didn't want to hear the down side of it. But by 1970, people were sort of starting to say well hang on ... all these other things that hadn't been addressed suddenly bubbling to the surface and so we were able to crystallise that and we wanted to compare the threats and the promises, but the promises just got completely shoved off the page. It was upstaged by this mountain of potential threats – as it seemed to us[2].

Firstly, the technical optimism of the 1950s had led to the increased mechanisation and chemicalisation of agriculture. The experiences of war had since the inter-war period produced new farming methods which were increasingly environmentally deleterious. These ideas were expounded in Rachel Carson's seminal text *Silent Spring* (1962) in which the ecological effects of pesticides were propelled into the public and political arena. The idea of a 'silent spring' served as a metaphor for the dangers of such technologisation of agriculture to birdlife which would effectively fall silent as a result of an interrupted food chain. Carson's work awakened many to the idea that something was not right with the industrial and commercial practices of the modern world. Concerns over the technologisation of agriculture had been expressed by Suffolk farmer Lady Eve Balfour in 1943 in *The Living Soil* which

[2] Peter Harper, interview November 2005

presented the case for an alternative, sustainable approach to agriculture, itself a response to the mechanisation and chemicalisation of modern farming methods in particular the use of chemical fertilisers[3]. Balfour's work contributed to the establishment of the Soil Association founded in 1946 by a group of farmers, scientists and nutritionists who observed a direct connection between farming practice and plant, animal, human and environmental health. Despite its formal establishment in the immediate post-war period its roots extend back to the inter-war period and the organic and rural revivalist movements, when confronted with the apparent failure of capitalism and the period of economic depression individuals began to explore alternative ideologies for a different model of society (Veldman 1994; Matless 1998; Conford 2001).

However, more notably, the technical optimism of the 1950s had fostered the development of nuclear technology, a more frightening and altogether apocalyptic application of science and technology. Commentators agree that perhaps more than anything the modern environmental movement of the post-war period was a reaction to the development of atomic technology which extended to both weaponry and energy production (see for example Veldman 1994; Pepper 1984; Dobson 1991). The two therefore became inextricably linked. The significance of the nuclear age to the

[3] Balfour was influenced by the work of Sir Robert McCarrison which she'd first encountered five years earlier and which argued that modern farming methods deprived the soil of fertility and thus less healthful produce. Intrigued by the different physiques of people he observed in India, McCarrison designed a series of experiments to test the links between diet and health. Despite criticisms from the medical world, Balfour was convinced and his work became a key text in the organic foods movement (Veldman 1994).

evolution post-war environmentalism is explored more thoroughly in 6.2 and chapter 7.

The experiences of these (mis)applications of technology as Harper (1976) describes them fostered new ways of thinking about humanity and environment. Definitions of 'environmentalism' have previously described it as "The ideologies and practices which flow from a concern with the environment" (Johnston 1981 in Dobson, 1991: 13). Noel Castree has since updated this definition to a concern for the protection of the natural environment from "the harmful effects of human activities" (Castree in Johnston *et al.*, 2000: 223). However, the new environmentalism was more than a set of ideas about the natural world and humanity's relationship to that world: this emerging eco-philosophy also encompassed ideas about society and man's relationship to fellow man and found expression in new ideas about technology and the means of production and settlement. According to Tim O'Riordan's typology (1976; 1977),

> Ecocentrism preached the virtues of reverence, humility, responsibility and care; it argues for low impact technology (but is not antitechnological); it decries bigness and impersonality in all forms; and demands a code of behaviour that seeks permanence and stability based upon ecological principles of diversity and homeostasis (O'Riordan 1976: 1)[4].

[4] By contrast, the technocentric ideology, "is almost arrogant in its assumption that man is supremely able to control events to suit his purposes" (*ibid.*).

This new environmental sensibility was therefore ideologically distinct to expressions of environmentalism since the late nineteenth century going beyond the conservationism which had previously characterised the prevailing environmental sensibility (Veldman 1994). In this way, the new environmentalism demonstrated a more *holistic* view of society and environment. Veldman (1994) and Pepper (1984) have argued that this was the result of a qualitative rather than quantitative shift and emanated from a changed conceptualisation of culture-nature relations stemming from a gradual but pervasive ecological awareness based on an alternative way of seeing the world (Pepper 1984). In exploring these ideas, Pepper (1984) states that what changed was not man's relationship with nature, but the way culture-nature relations had been imagined since the Enlightenment. Prior to this period in history, Man had been viewed as separate from and 'othered' to nature; placed outside of and distinct from the natural world, occupying separate realms of existence. Instead the eco-centric vision recognised the interconnectedness of humanity and nature and therefore sought instead a more organic approach to existence.

To consider further the nature of the new environmentalism of the post-war period, Veldman (1994) argues that expressions of environmentalism in the late nineteenth century were limited in two ways. Firstly it exhibited a distinctly 'conservationist' sensibility, limited to a concern with nature and amenity conservation. Secondly, Veldman (*ibid*) states that the practice of environmental protection was characterised by what she describes as 'single issue' campaigning, concerned largely with individual, often local causes. The modern environmental movement was thus distinct in its display of a more widespread concern about a plethora of issues which its proponents saw as interconnected. Unlike earlier expressions it no longer saw man as 'othered' to nature. Expressions of environmentalism since the 1960s adopted "more holistic, more radical forms of environmental concern" (Veldman 1994: 209) which sought to challenge not only environmental abuses but also a number of societal ideals "opening up our minds and our organisations to new ideas about fairness, sharing, permanence and humility" (O'Riordan 1976 in Pepper 1984: 14). Groups that emerged from this time therefore demonstrated a more holistic view of 'environment' which incorporated both the natural and human realms and argued that correcting environmental abuses demanded more than just conservation in an approach which included social, political, and economic reform.

Although this new version of environmentalism built on the sentiments which informed earlier expressions through ideas of conservation, rural preservation and organicism, the environmentalism of the post-war period differed from its previous expressions by way of a more active and thus *radicalised* cohort. Not only did this new version of environmentalism differ in its conceptualisation of the natural and human worlds, it also exhibited a more radical and, crucially, *active* sensibility (O'Riordan 1977; Veldman 1994) which, critically, was directly linked to the anti-nuclear movement, a reaction to the technical optimism of the 1950s (Veldman 1994).

Not only did the early Green movement offer a critique of modern society it also suggested an ecologically motivated model of reform (Veldman 1994). Dobson (1991) distinguishes between "those who seek environmental reform without corresponding social and economic reform, and those who believe that the former is not attainable without the latter" (*Ibid.*: 13). Whilst government and industry generally continued in its broader policy of economic growth, the proponents of 'modern environmentalism' were distinct from both mainstream society and previous environmentalists in their alignment to the latter ideology, advocating total societal reform, firm in their belief and "conviction, conviction that a better mode of existence is possible" (O'Riordan 1976: 21). The 'early Greens', as Veldman (1994) characterises the proponents of the new environmental movement, perceived this as only possible through a restructuring of society based around ideas of localism, organicism, community, eco-feminism and an ecological world view.

These various models of reform can be found in several key 'Green' publications. The texts, their authors and the establishment of groups with which they were associated were critical to the development and adoption of the modern environmental ideology. These key 'environmental' texts are outlined in an edited collection by Andrew Dobson (1991), which provides a general grounding in the ideas associated with the movement. Several influential texts are commonly cited as critical to the development of the essential Green ideology. Pepper (1984) suggests that the principle ideas of counter-modern environmentalism were expounded in three landmark publications. *The Limits to Growth* (Meadows *et al.* 1972) attempted to enunciate the range and nature of the problem linking the problem of exponential population growth to finite natural resources; *A Blueprint for Survival* (The Ecologist 1972) offered the solutions required through ideas of localism, community and ecologism; and *Small is Beautiful* (Schumacher 1973) mingled the practical approach with a consideration of the philosophical underpinnings of the movement (Pepper 1984) advocating 'appropriate' small-scale technology (see section 6.2). Further environmental ideologies were enunciated expressing ideas about the dangers of economic and demographic growth (Hardin 1968; Meadows *et al.* 1972). Concerns over an increasing global population, were also being increasingly implicated in the impending environmental crisis expounded by Paul Ehrlich (c1971; Ehrlich and Ehrlich c1970) and later Meadows *et al* (1972); technology and industrial production (Schumacher 1973); decentralization (The Ecologist 1972); self-sufficiency (Seymour 1976) and Organicism (Balfour 1943)[5]. Veldman (1994) argues that these ideas were demonstrated in a comprehensive social critique by Barbara Ward in *Spaceship Earth* (1966), ideas that had also been articulated through subsequent texts *One Earth* (Ward and Dubos 1972)[6] and *Progress for a Small Planet* (Ward 1979) which discussed the interconnectedness of economic and political structures and of the environmental degradation of the planet. Such texts were influential and sufficiently pervasive to stimulate thinking regarding the 'environmental' dilemma facing society and served to effect a dominant 'way of thinking' (Dobson 1991) which signalled what Veldman (1994) describes as the 'greening of Britain'. The ideologies articulated through these texts were formalised through the institution of

[5] See Dobson (1991)
[6] This text was written for the UN Conference on the Human Environment which took place in Stockholm in 1972.

several eco-activist groups such as The Conservation Society, an essentially *radical* group formed in 1966, established in response to environmental constraints placed initially on population growth and by 1970 economic growth, and Friends of the Earth, established in 1970 (*ibid.*).

Critically, the new environmental sensibility was linked to an emerging counter-culture which Veldman (1994) argues was especially influential to the ways these ideas were channelled. This counter-cultural movement had been gaining momentum in Britain since the early 1960s, sparked initially by distinct cultural fractures in North America from which the romantic and idealistic 'Hippie' movement, which itself drew on the romanticism of the eighteenth century, emerged (O'Riordan 1976; Winter 1996). As AT theorist and later CAT affiliate Peter Harper confirms, engagements with alternative technology were "very mixed up with the social movement ... with the youth movement and cult culture and Hippies"[7]. This new cultural movement also exhibited a 'drop-out' sensibility which rejected, as they saw them, the confining norms and values of post-war society turning instead to self-expression through sensory exploration. Not only did it reject the norms and values of authority it also rejected the sense of authoritarianism (see chapter 7), asserting instead an arrogance of youth which saw that it knew better, as Peter Harper explains "typical young people, they don't want people to tell them what to do, they want to control it, they want their own world and to run it themselves ... it was nice to be able to out flank old people and just sort of imagine that their world is completely

[7] Peter Harper, interview November 2005

irrelevant and is fading away or self-destructing or something"[8]. Given this rejection of conventional society these groups were ostracised and 'othered' to mainstream culture on the basis of cultural difference. For these reasons, the philosophy that fostered the development of CAT is characterised here as *counter-cultural environmentalism*.

6.1.2 The Alternative Technology Movement: A Critique of Society and Technology

Although the counter-modern environmental movement in Britain certainly accommodated expressions of this romanticised view of the world some factions chose to conform to certain societal norms demonstrating instead a more pragmatic approach to the problems of society which as they saw it could be remedied, at least in part, through the application of alternative technologies. They were affiliated to the counter-cultural movement, a group influenced not least through the work of the economist E.F. Schumacher (1973) in his critical text *Small is Beautiful* (1973) both the title of his work but what also became a principle affiliated with the counter-modern environmental movement to embody all that the new eco-philosophy stood for. Schumacher expounded the need for 'appropriate' human-faced technology; a model of reform based on decentralised, small-scale, simplified and critically, technologies that were *appropriate* to the economic and physical environments for which they developed. German born Schumacher had been an economic advisor for the National Coal Board during the 1950s and 1960s who had "walked the corridors

[8] *Ibid.*

of power" (Gerard Morgan-Grenville in Centre for Alternative Technology 2000: 6) and whose position as which had drawn his attention to questions of energy resources. In his best-selling text, Schumacher demonstrated that the environmental crisis constituted only one part of a "three-pronged crisis" facing post-war industrial society. Energy shortages, the breakdown on human relations under large-scale industrialisation and a commitment to economic growth for Schumacher constituted the impending global disaster facing humanity (Veldman 1994). Although his ideas may have been unorthodox, his Establishment credentials afforded his new principles of production the modicum of credibility the movement required to propel its ideas to a more conventional audience beyond the already conversant and converted minds of western 'alternative' culture. However, it must be noted that during the 1970s engagements with alternative technologies remained largely within the realms of this growing counter-culture. Articulating the ideals of the wider Green critique, 'small is beautiful' became a metaphor for a new ecologically sustainable society.

These ideas about new forms of technology as a *practical* expression of the new environmentalism expressed by the counter-cultural environmentalists began to emerge from the early 1970s. Taking a historical view of the philosophy of technology, the Alternative Technology (AT) movement picked up where history left off: reviving a project abandoned with the eclipse of 19th century utopianism (Winner 1979). Many before the AT practitioners of the 1970s had renounced the autocracy of complex and large-scale technologies, perhaps most notably the sociologist and philanthropist Robert Owen (1771-1858) through new models of community during the nineteenth century (see chapter 7). Owen was one of the first to ponder what form the reconstituted world created by the technology of the industrial revolution might take. Appalled by the paradox of the capacity of the new technology to create both wealth and poverty, Owen attempted to build new communities (New Lanark, New Harmony [or Harmony Hill], Concordium and Villages of Co-operation) using industrial development to create a new and harmonious social order. Re-asserting Owen's utopian ideologies, social thinkers in the late nineteenth century, namely William Morris and the Guild Socialists also renounced the autocracy of complex and large-scale technologies given their removal from human-scale production (Pepper 1991; Harrod 1999).

However, more than these earlier articulations, the AT movement a century on, in an expression of the wider counter-cultural environmental movement to which it was affiliated, demonstrated a more pragmatic, radicalised, political vision of society and technology. As demonstrated above, for environmentalists in the post-war period, technology (as a representation of modernity), particularly that pertaining to the production of energy, was grossly implicated in the perceived destruction of the natural and social environments. Engagements with new forms of technology were therefore considered one way in which the problem could be approached. AT activists were interested in the technologies that would serve a society radically different to the industrial capitalism of the 1960s (Dickson 1974). They were interested therefore in the transformation of technology systems (and society) into forms that did not threaten ecological catastrophe, and which were much more convivial in use founded on principles of simplicity and thus ecological harmony (Smith 2005). This was to be achieved through the use of diverse, locally available and significantly *renewable* sources. The basic criterion for these new forms of technology was a reduction in both complexity and scale which "demand less energy, less material, less mechanisation, less narrow expertise and small production units" (Harper 1974: 153). This reduction in scale would ultimately lead to "environmentally benign technologies" (*ibid*: 154).

The AT movement brought together and was mobilised by an ostensibly disparate group of individuals, both practitioners and theorists, increasingly concerned over the function, place and role of conventional technology in society. One of the most prominent theorists was Peter Harper, an eco-activist and writer and later affiliate of the Centre for Alternative Technology. By the early 1970s Harper was editor of the bi-monthly journal *Undercurrents*, an example of the alternative press within the pages of which the philosophies of the AT movement were articulated[9]. Harper[10] had

[9] This was initially very much within the realms of the alternative press, but by 1975 it had been picked up by the stationer and newsagent WH Smith through which its circulation increased (Peter Harper, interview November 2005). As well as *Undercurrents*, Harper was also involved with and contributing to two other journal publications: *Science for People* and *Radical Science Journal*, which Harper describes as "personal, popular, earnest", and "the Marxist and heavy thing" respectively. Harper describes *Undercurrents* as "the anarchic thing" adding that he was "quite happy to be involved in all of them really; they all seemed to be important" (*Ibid.*).

[10] Harper was then studying for a PhD in behavioural biochemistry at the University of Sussex. It was through this environment that Harper had ended up at the Nobel Foundation conference in 1969 where he'd met "a lot of Nobel prize winners and lots of important people" who he states had become interested in *him*. Harper had subsequently become part of a North European-wide network of similarly disaffected young people (mainly Swedes, Danes, Dutch and Germans), concerned with the state of the world in the early 1970s. Through this network Harper had ended up at the Stockholm Conference where he explains he'd met "lots of very famous people" amongst those he remembers, the Anthropologist Margaret Mead and eminent twentieth century Chemist Linus Pauling, "individuals who'd written all the text books that we were using" whom Harper describes as 'demigods' and with whom he revelled in being able to discuss the state of the world (Peter Harper, interview November 2005).

in his words 'dropped out' in the late 1960s after spending his early adulthood as a post-graduate biologist in academia.

In a retrospective of the alternative technology movement, Malcolm Hollick (1982) describes the alternative technology community as a 'melting pot' of interests and philosophies. This was reflected in the variety of labels used to describe the different proposals: "intermediate ... radical, self-help, democratic, people's progressive, low cost, autonomous, soft, utopian, liberatory, non-violent, convivial" (Hollick 1982: 213)[11]. These different descriptors illustrate a wider issue of problems of definition: For example, Jéquier used the term 'appropriate' as the descriptor of choice for the 1979 OECD funded *Appropriate Technology Directory I* (Jéquier 1979) and *Appropriate Technology Directory II* (Jéquier 1984). Whereas Peter Harper started out with the term 'soft' moving onto 'radical' and finally settling on 'alternative' as the most appropriate terminology due to its synonymity with ideas about the rejection of mainstream society, a descriptor which became more widely adopted and used as an umbrella term for the multitude of variations[12].

Within what Hollick (1982) refers to as this 'pot-pourri' he argues that there were two broad divisions: those whose prime concern was those of developing countries and those who were more interested in the environmental and resource problems

[11] See also Darrow and Pam (1976), Jéquier (1979; 1984), Harper (1974; 1976) and Boyle and Harper (1976).

[12] Peter Harper, interview November 2005. Harper is widely attributed with coining the phrase 'Alternative Technology' at the conference at the London School of Architecture in 1972. However, *The Oxford English Dictionary* (prepared by J.A. Simpson and E.S.C. Weiner, 2nd Edit., 1989, Oxford: Clarendon) attributes its first use in the same year to Edward Goldsmith in *The Ecologist*.

associated with the use of conventional technology in developed nations. The former proclaimed their interest in *appropriate* technologies, the latter in *alternative* technologies. To enunciate the difference between these two descriptors, 'appropriate' described a simple (as opposed to complex) technology appropriate to the level of civilisation in developing nations; 'alternative' described a simpler and therefore 'other' option to the large-scale technologically complex systems of the scientifically and technology developed nations of the western society (although the practitioners of these technologies each claimed the relevance of these areas to the other). Although there were fundamental differences between *alternative* and *appropriate* technologies, the AT movement brought together the two fields and these differences were eclipsed by a common founding political philosophy which subsequently worked to cohere a community of AT practitioners and theorists.

For Harper (1976), this unifying quality was a commitment to the political Left, a philosophy through which the essence of the AT movement could both be articulated and the principles of which it embodied. This was also implied by his use of the term 'radical technology' in 1976 as the title of an article in *Undercurrents*, in which Harper employed the rhetoric of this political philosophy to rally the movement:

> Let's say we're into *liberation*. We have to break through the political, economic, social and psychological forces that constrain and oppress us. The trouble is these forces hold one another together in a web of mutual reinforcement so consistent that its hard to know where to begin loosening their grip: patterns of ownership, status games,

the way you work, what you learned at school, what the neighbours think, who gives the orders, what turns you on, what you see on TV, what you can or cannot buy[13].

Reflecting the ideals of the Socialist political philosophy with which it identified, the alternative technology movement was a practical critique of modern power configurations. For critics of the movement this was exactly what alternative technology could achieve, for beyond the practical, engagements with AT worked to consider more critically the place of technology in society.

Two prominent contemporary AT theorists were Langdon Winner and David Dickson[14]. Both argued that over and above an obsession with the nuts and bolts of the technology itself (a criticism of the movement Winner (1979) described as 'hardware fetishism') through engagements with alternative technology, existing configurations of power could and should be critiqued. In the AT movement Winner (1979) saw that a critical imagination was being reborn through inchoate ideas about projects in 'alternative' or 'appropriate' technology. For Winner (1979) the AT movement posed a challenge to what he described as a "powerful, thoroughly stultifying orthodoxy" (*Ibid*: 75) which had hitherto governed the western world view of technology and had remained unchallenged. Winner (1979) argued that this had begun with Francis Bacon's *Great Instauration* (1620) and matured into a central theme in the religion of 'progress' of the Enlightenment and the industrial revolution

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[13] Harper, P., 1976, 'Radical Technology', *Undercurrents* 15, 11-13

[14] In the late 1970s Langdon Winner was Professor of Political Science and Technology Studies at MIT. In the early 1970s David Dickson was Secretary for the British Society for Social Responsibility (Peter Harper, interview November 2005)

and which still holds considerable power over conceptions of the modern world. As Winner enunciated:

> Despite the superficiality of its premise, the technological orthodoxy has retained considerable power over our conceptions of what the modern world is about. This comes as no accident. The wonderful development in industrial and scientific technics of the past two centuries have enabled individuals and social classes of all sorts to identify with technological progress as a way of life. Indeed, so great was the boon brought about by the combination of new discoveries, inventions and products that only the workings of technology were thought worthy of consideration. Questions of meaning could be indefinitely postponed (Winner 1979: 77).

This argument built on that of fellow AT theorist David Dickson, who in an article published in *Undercurrents* magazine, like Harper (1976), argued that the control of technology by the State and large-scale corporations is used as a way of confining the general populous to certain patterns of accepted behaviour, namely those that coincide with the political and economic norms of a capitalist society. Dickson (1977) argued that for these reasons the alternative technology movement was important because the objectives of capitalist society were environmentally and socially malevolent. Where the AT movement recognises this malevolency, in the face of this evidence capitalist society *reaffirms* the importance of the economic growth responsible for it.

> ...if a particular system of social organisation and control is maintained by a particular type of technological development, then the defence of the technology under that system becomes part of the defence of the system itself, To put it another way, if technology is not neutral, but is a concrete manifestation of the dominant power relations within a society – in our case the class relationships of capitalism – then to oppose the dominant patterns of technological growth is equivalent to opposing those power relationships (Dickson 1977: 22).

AT was not just about the environmental and social effects of conventional technology, it questioned the very heart of the fundamental structures and patterns of the social system adopted by the Western world, i.e. capitalism. As far as Dickson (*ibid.*) was concerned, to question capitalism was the single most important contribution that the AT movement had to make to the political debates of the 1970s, over and above the design of increasingly efficient solar panels or effective organic fertilisers. In his invitation for dialogue on the political philosophy of alternative technology, Winner (*ibid.*) states that the structures and processes of scientific technology are universally acknowledged as primary aspects of modern life and as such was baffled as to why it remained an area devoid of philosophical importance.

At least, by virtue of its radicality, the alternative technology movement in the early 1970s had seemingly opened up this area for philosophical discourse amongst the scientific community as they sought to question the orthodoxy and authority of technological progress through "a fundamental re-examination of the role of technology in modern societies" (Harper 1976: 11). For Harper, alternative technology was "a good place to get your fingers into the crack. Out of that assumption a syncretic model is developing which is both descriptive and normative, and suggests that real socialism will require an assessment of the whole basis of productive activity: machines, methods, products, work-places, work patterns, training, allocation of work, loci of control, reward systems, distribution, pricing, economic co-ordination, attitudes, engineering principles, conventional scientific theory"[15]. AT therefore went beyond the nuts and bolts of the machinery and was an ecological way of critiquing the power structures of post-war society.

Despite this move towards what Winner was calling for, there were some areas in which he considered that they didn't go far enough arguing that there remained an uncritical distinction between 'technology' and 'society'. In this way, for Winner (1979) and others such as Darrow and Pam (1976), technologies were never neutral: they were both socially constructed and determining as they legislate and govern the fundamental patterns of life. Winner (1979) argued that in modern society, a wide variety of refined techniques, apparatus and socio-technical systems provide the basic patterns for everyday human activity. The cumulative effect of these innovations in industrial production, mechanical transportation, electronic communication, modern warfare, modern architecture, medicine and household convenience resembles a picture of the "*constitution of modern life*" (*Ibid*: 77). So in this way, what the alternative technology movement was attempting to achieve was a replacement for the technologies associated with these patterns, but as far as a re-

[15] Harper, P., 1976, 'Radical Technology', *Undercurrents* 15, 11-13

ordering of the patterns themselves was concerned, according to Winner's argument, AT failed to offer a serious alternative to modern life.

As Harper confirms, the model of alternative technology was seen as a self-conscious model for Utopia: "a lot of people reading [*Undercurrents*] started to describe this as Utopianism, Applied Utopianism; this is how to construct Utopia; this is the technology of Utopia"[16]. However, others saw this as a source of criticism (Veldman 1994) in the sense that the widespread expansion of the niches they created "would be virtually impossible within the existing structure of society" (Dickson 1974: 99). As Dickson questioned; "is it possible to contemplate an alternative form of social development to that which has resulted in large-scale, centralised patterns of industrialisation, and the alienated life-style that has come with it? The tools and machines required to maintain this alternative world necessarily embody a different set of social and cultural values from those we possess at present" (Dickson, 1974: 96). For Dickson (1974) and for Winner (1979) it was also the challenge for AT to formulate an entirely remodelled society rather than simply perpetuate existing structures through new hardware. In this way both Dickson (1977) and Winner (1979) argued that AT only went part-way towards a truly alternative philosophy of technology.

Regardless of these critiques, the anti-nuclear protest movement confronted society with a new reality of the connection between humanity and its environment which latched on firmly to the energy issue given its unique connection to both environment

[16] Peter Harper, interview November 2005

and society. These two things coalesced through new visions of energy technologies through which the movement could channel both its critique of and solution to industrial society.

6.2 Alternative Visions, Alternative Landscapes: Gerard Morgan-Grenville and Re-envisioning of Industrial Landscape in the Hillscapes of mid-Wales

Having considered the wider ideological and socio-political context that fostered the development of a practical exhibition of alternative technologies in the early 1970s, the chapter now considers the biography of the founder of the Centre for Alternative Technology (CAT) in relation to its development and the landscape in which it was embedded. This will follow a largely chronological history considering Morgan-Grenville's experiences and influences in his early life from the late 1930s through to the crystallisation of the idea for the Centre in the early 1970s. This is followed by a consideration of the relationship between the landscape in which the Centre was established and the wider trend towards the institution of alternative living in the region and the planning process which facilitated its establishment.

6.2.1 Gerard Morgan-Grenville: An Innate Environmentalism?

The CAT project was the ecological brainchild of Gerard Morgan-Grenville, a member of the privileged British upper-classes. The vision of a practical demonstration of alternative technologies was borne out of a burgeoning environmentalism that had begun to settle within him in the 1960s when the founder was in his early thirties[17]. By this stage in his life Morgan-Grenville had become both uncomfortable with his privileged class position and increasingly disillusioned with the modern world. The two feelings combined manifested in the form of an environmental activism, a sensibility complemented by a socialist political bent, which he himself positions as somewhat contrary to his conventional background (Morgan-Grenville 2001). Through the CAT project Morgan-Grenville hoped to bridge the ideological divide between the conventional and alternative worlds to bring a solution based on new visions of environment, society and technology to what he and many others saw at this time as a very real risk of ecological meltdown, to the consciousness of the wider populace.

An environmental sensibility had been instilled in Morgan-Grenville from an early age, which caused him later to speculate as to whether he had inherited a genetic predisposition to the natural world (Morgan-Grenville 2001). The influences of Morgan-Grenville's upbringing manifested themselves in two ways. Not only did they serve to provide him with a contextual reasoning for his own place in the world, it also induced in him a sense of nature and environment. This was embedded deep in Morgan-Grenville's psyche vicariously through his mother's (and her mother's before her) interest in the natural world and humanity's relational place in that world. Morgan-Grenville's mother Elizabeth (née Renshaw) had been an active participant in disseminating this message. In his autobiography Morgan-Grenville recalls how,

[17] Morgan-Grenville was born in 1931

echoing the rhetoric of the concept of natural limits to growth later articulated by (Meadows *et al.* 1972) his mother "had long preached the need for humanity to live within the finite resources of planet Earth" (Morgan-Grenville 2001: 154). Elizabeth Morgan-Grenville had been an early member of the Soil Association and demonstrated "an instinctive feeling for self-sufficiency" to which he attributes directly his own connection to nature and what he describes as an environmental "consciousness"[18]. As a demonstration of this sensibility, and her prophetic sense of environmental decline, in a radical step, in 1949, influenced by the work of Eve Balfour, an individual with whom she shared a common position in life, she had addressed a farmers' meeting warning of the 'new' chemical methods of agriculture, at the end of which Morgan-Granville recalls "there was total silence ... they were polite enough not to boo but it was everything short of that"[19]. At this point in time, one characterised by technical optimism, Morgan-Grenville rationalises this response by stating that "anyone who spoke against pesticides was considered either dangerous or mad"[20]. Having the fundamental principles of the modern environmental movement instilled in him from an early age as part of a wider family value system, Morgan-Grenville cites his mother's influence directly as the source of his environmental activism[21].

The specificities of Morgan-Grenville's environmental sensibility can be further interrogated through the oral and written histories of his youth which are inflected

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[18] Gerard Morgan-Grenville, interview April 2007
[19] *Ibid.*
[20] *Ibid.*
[21] Morgan-Grenville (2001); Gerard Morgan-Grenville, interview April 2007

with a particular rural sensibility impressed upon him through a seemingly idyllic childhood spent largely in the protective realms of the unspoilt West Sussex and Gloucestershire countryside within or just beyond the confines of the country houses in which he grew up and the landscapes in which he spent several family holidays both in Britain and abroad[22]. This is particularly acute during the years of the Second World War when in his autobiography Morgan-Grenville recounts several stories of unfettered adventure in the Gloucestershire countryside (Morgan-Grenville 2001). It was also during this time that the influences of his mother were instilled within him most actively. After an early childhood characterised by relative parental absence, due to war staff shortages he spent a greater amount of time with his mother ambling in the countryside engaged in pursuits such as memorising both the Latin and English names of particular flora. Although Morgan-Grenville acknowledges that "as a son who adored his mother, it is inevitable that she will be viewed through rose-tinted spectacles" amongst her many qualities and attributes Morgan presents his mother as a keen rider, fly-fisher, proficient botanist and ornithologist with an intense appreciation of nature: so proficient that her collection of East African flowers is now housed in the Natural History Museum (Morgan-Grenville 2001: 23). The significance of the influence of his mother's sensibilities requires little further elaboration.

Given his class background the founder's upbringing had afforded him a private education at Eton College and subsequently an eclectic career history prior to his

[22] Morgan-Grenville grew up at Hammerwood House in West Sussex and spent a year at Withington Court in Herefordshire during the Second World War before boarding at Heatherdown School which had been evacuated to Downton Hall in Shropshire for preparation for Eton (Morgan-Grenville 2001).

involvement with alternative technologies. On leaving school Morgan-Grenville undertook a brief and reluctant spell in the armed forces which saw him fast track through the ranks of the Rifle Brigade to Lieutenant and aide-de-camp to revered senior officer and World War II veteran General Frankie Festing, an individual whom he held in great esteem[23]. Of his superior he writes:

> He taught me many valuable lessons. Foremost of these was his measured approach to Important People. He was seldom impressed by Position, realising that those at the top often arrived by virtue of luck, favour, ruthlessness or dead men's shoes. I never saw him kow-tow to anyone nor denigrate his colleagues for reasons of personal preferment. Titles and wealth left him unmoved ... it was this man more than any other who set me on the road to independence in thought and action (Morgan-Grenville 2001: 78).

To Festing Morgan-Grenville also attributed the instillation of a particular set of values and qualities which would later influence his individual working practices (see chapter 7).

However, a career in the armed forces was not how Morgan-Grenville envisioned his future and having decided to leave the army at twenty years of age he experimented with various positions in the commercial field. These jobs included corrugated plastic sheeting and power tools sales, both of which granted him the luxury of a global travel itinerary. However, Morgan-Grenville recalls that he soon became aware of the

[23] Morgan-Grenville's father and grandfather had both served in the same regiment before him (Morgan-Grenville 2001).

limitations of being an employee and with his brother, subsequently decided to establish an import/export company, a situation which might afford him the independence he desired. As it transpired, Morgan-Grenville got what he wished for as he was consequently sacked by his employer for moonlighting. Despite early teething problems, his earlier sales experience proved indispensable and the company became a commercial success with a lucrative French subsidiary[24].

It was during this period in his life in the early sixties that Morgan-Grenville's feelings of restlessness began in earnest. Having decided to leave his brother John at the helm of the business, his next venture took Morgan-Grenville to North-West Europe to pursue barging as both a lifestyle and a commercial enterprise, during which his feelings of disquiet which were to materialise into what he describes as "Green Fundamentalism" started to evolve within the consciousness of the CAT founder (Morgan-Grenville 2001: 155).

6.2.2 Environmental Activism: Ideological and Practical Influences

Although Morgan-Grenville fails to recall the exact moment the idea for a national centre for alternative technology crystallised in his mind, in his autobiography he provides some insight into his general mood, activities and influences leading up to this period in his life. Morgan-Grenville recounts how by the time he'd reached his mid-thirties he was in a position of relative financial security having passed the usual

[24] Established in 1957, Dexam International Ltd still operates as a retail trade supplier of kitchen and cookware.

milestones of a thirty-something (Morgan-Grenville 2001)[25]. However despite what he describes as "outwardly enviable circumstances" he recalls a growing sense of unease:

> I was increasingly prey to a profound discontent which, initially I found hard to articulate ... It permeated my whole life and gradually threw into question all that I had been doing ... I began to perceive my existence against a global perspective and found it wanting in relevance (Morgan-Grenville 2001: 154).

The 'Green Fundamentalism' which was beginning to settle upon him was all part of feeling a sense of lost purpose. The founder recounts how he began to ponder lifestyle generally, specifically the perceived profligacy of the western world. By the mid-1960s this had germinated into a growing sense of unease with the world.

Although he managed to find company with those whom his embryonic ecocentrism could be explored he found himself alone in his drive to act which he found frustrating and which subconsciously angered him. Morgan-Grenville also writes of being informed by articles in what he describes as the "non-tabloid press"[26] which questioned this witnessed profligacy and advanced the notion of finite resources which, as he saw it, were being squandered and subsequently polluting the planet

[25] Morgan-Grenville does not state what he considers these to be, however by this time he was married, living in a home that he owned with a secure income.

[26] Although Morgan-Grenville fails to recall which publications he was influenced by it is likely that here he is referring to broadsheet newspapers (Morgan-Grenville 2001; Interview with Gerard Morgan-Grenville, April 2007). However, although Morgan-Grenville does not cite these publications, an 'alternative press' emerged during this period consisting of several journals with increasing circulation. Peter Harper recalls three main journals to which he made regular contributions. These were *Undercurrents* (which he also edited), *Resurgence* and *Renew* (Interview with Peter Harper, November 2005).

(Morgan-Grenville 2001: 158). Further research led him to American sources which recorded 'environmentalism' as an ideology linked to a particular emerging sub-culture.

Morgan-Grenville subsequently flew to San Francisco, a mission which afforded him several experiences which instilled in him three primary considerations. Firstly, Morgan-Grenville found a greater ecological awareness amongst the capitalists he held responsible for his witnessed environmental ills than he had anticipated. Armed with an array of introductions, Morgan-Grenville – to his surprise - managed to interview several leading businessmen and politicians[27]. Morgan-Grenville found those whom he describes as 'business leaders' in the United States were surprisingly aware of the interconnections between their capitalistic modes of production and environmental degradation[28]. Amongst the people with whom he sought opinion, he found a uniformity of feeling, half of whom believed that only a 'bottom-up' approach could even begin to address the situation[29]. Morgan-Grenville states that he was spurred on by this experience as it suggested to him that he would find greater sympathy for his eco-philosophy in Britain than he first anticipated[30].

Secondly, his pilgrimage to the United States bought him into contact with his cultural 'peers'. In California this consisted of the Hippie communities living in the

[27] Gerard Morgan-Grenville, interview April 2007
[28] *Ibid.*
[29] Morgan-Grenville could not recall the names of the individuals he met (Morgan-Grenville 2001; Gerard Morgan-Grenville, interview April 2007).
[30] Gerard Morgan-Grenville, interview April 2007

surrounding hills of San Francisco. Here he found several quite different congregations. He describes how some

> embraced the need for organisation, for hard work to construct shelter, grow food, and project a positive face toward their brave new world ... [whilst] others lived in rank squalor, devoid of imagination or leadership, dissolute, irrelevant to the outside world and ultimately to themselves.
>
> Their membership was disparate. There were draft dodgers, unemployed university graduates a-plenty, lay-abouts living on state benefit, numerous girls of rich families living off their parents, writers and artists of every kind, and a plethora of guitarists ... In spite of their genuine concern and reformist ardour, these groups were notoriously fragile. People came and went, some to find other groups, more in sympathy with their particular outlook, some disenchanted with the simple life (Morgan-Grenville 2001: 157).

These groups clearly represented values antithetical to his conventional background. In addition to the fact that they dressed differently, in his own words, "They looked exceedingly scruffy, wore outrageous clothes, shunned the barber, they held custom to ridicule, rejected Authority, placed a low value on wealth, favoured disarmament, renounced nuclear power and were prepared to live simply 'so that others might simply live'" (Morgan-Grenville 2001: 155). Although he acknowledged the cultural differences between himself and those he encountered in the San Franciscan hills, the principles upon which they had founded this sub-culture were sufficiently compelling to negate these conflicts through the recognition of a common eco-philosophy.

However, despite his respect for these groups and recognition of a common eco-philosophy Morgan-Grenville was of the opinion that these communities were headed ultimately for self-destruction. Despite their apparent rejection of material wealth Morgan-Grenville states that the majority of those he encountered had private incomes, which meant that they did not have to work to sustain themselves so could afford to live in the way he'd found them. This lack of a desire to work in Morgan-Grenville's view deemed these communities unrealistic as they were not self-sufficient which rendered them ultimately unsustainable. As Peter Harper agreed "you couldn't run the planet on a bunch of dope-smoking Hippies sitting at home all day getting smashed! You had to keep things running and it had have the energy, it had to be sustainable and it had to work"[31]. As far as the CAT project was concerned, what this experience provided Morgan-Grenville with was an idea of the kind of people he would need to attract. The community he imagined would need to be peopled by those who had little money and therefore who would have an incentive to work in order to live[32]. Through direct communion with this sub-culture, Morgan-Grenville recalls that he came to the conclusion that change could only occur through a vast bottom-up approach which germinated into an idea based on *self-sufficiency* (Morgan-Grenville 2001).

Thirdly Morgan-Grenville's visit to California afforded him his first experience of amateur attempts to harness alternative energy sources in the form of small windfarm projects that he witnessed through the groups he had communed with in the San

[31] Peter Harper, interview November 2005
[32] Gerard Morgan-Grenville, interview April 2007

Franciscan Hills (Morgan-Grenville 2001). Of these installations he states "I looked at those and they worked, they seemed to be working. Nobody made any extravagant claims for them it's just that there they were, they were working. People had been prepared to put up some money and try and build them"[33]. Having witnessed what he saw as a successful functional example, regardless of how pitiful it may have seemed at the time, Morgan-Grenville's personal conviction was one of action. The prevalence of these three elements, a captive commercial and industrial arena, willing disciples and the working technology, were sufficient to provide Morgan-Grenville not only with the idea but, spurred on by his experiences across the Atlantic, also the conviction and drive for an exhibition of alternative technology through a medium that could bridge the gap between conventional and alternative ways of seeing and living: a way of communicating the ecological message of alternative society to those that controlled the structures and mechanisms of conventional society.

Morgan-Grenville states that as part of the movement certain ideas about the world that were emerging at this time had a considerable effect not just on him "but on lots of people: it was a sort of common ground that we all had"[34]. Amongst his other socio-political and cultural influences Morgan-Grenville cites directly the work of Barry Commoner who had written on the issue of environmental degradation and its links to the social, political and economic forces that govern society, in both *Science and Survival* (Commoner 1967) and *The Closing Circle* (Commoner 1972) in which

[33] *Ibid.*
[34] *Ibid.*

he described western capitalism as the "new barbarism" (Commoner 1972: 296)[35]. The ideas propounded in these texts resonated strongly with Morgan-Grenville and the message he was ultimately attempting to communicate through the project. Morgan-Grenville also cites the work of the biologist Paul Ehrlich who as noted in chapter 6 had written extensively on the issue of population pressure (Ehrlich and Ehrlich c1970; Ehrlich c1971). Typical of his fellow counter-modern environmentalists, Morgan-Grenville's recalls that he was also positively influenced by the ideas expounded in *Small is Beautiful* (Schumacher 1973), *Silent Spring* (Carson 1962), *The Complete Book of Self-Sufficiency* (Seymour 1976) and *Blueprint for Survival* (Goldsmith 1972)[36]. Morgan-Grenville describes such as texts as crucial to the movement and in Morgan-Grenville's words it was the passion contained in these texts that "helped generate the energy that went into the struggle"[37].

Counter-modern environmentalists, both those expounding the ideas and their disciples who followed them, clearly shared a series of common beliefs about the world in the post-war period. However, what united these seemingly disparate groups most powerfully was their renunciation of nuclear power. Morgan-Grenville recalls that "it was the mainspring for things, for the course that people took"[38]. To them, nuclear technology represented all that was authoritarian and secret, sinister and dangerous, described by Morgan-Grenville as a 'culture of deceit' (Morgan-Grenville

[35] Barry Commoner later wrote *The Poverty of Power: Energy and the Economic Crisis*, a more specific text about energy production which recognised its interconnectedness to environmental degradation and economic decline in the US (see Commoner 1976).
[36] Gerard Morgan-Grenville, interview April 2007
[37] *Ibid.*
[38] *Ibid.*

2001). A core principle for the Hippie communities, and so it was for Morgan-Grenville: As the CAT founder recalls: it "provoked the most passionate opposition and reinforced anger at other mainstream activities hostile to the public interest and threatening to environmental sanity" (*ibid*: 162). Most importantly however, it could be fatally dangerous to man and nature and facilitated the development of nuclear weaponry. The witnessed devastation that atomic technology effected during the Second World War presented post-war society with an abject reality of an apocalyptic world; a risk that most wished to diminish.

For Morgan-Grenville nuclear power was symbolic of everything that was wrong with the world as it represented the ultimate potential of science and technology, the principle upon which modern western society was founded. Such was the centrality of the nuclear issue that it was perhaps Morgan-Grenville's opposition to nuclear power that provided him with the framework for a project through which he could communicate his ideas about the world and his model of reform through the demonstration of alternative energy technologies. However, what was also significant about the nuclear issue was that, for Morgan-Grenville it represented what he characterises as 'The Establishment'. In his words this was

> an unknown number of people who for one reason or another were high up the pyramid, high up the tree. They might have been people with public school educations, they might have been senior military, they might have been almost certainly Conservatives ... they were less than you might think of business people, they were the people who most people considered round the country ... at one end of

> the spectrum they were who one might consider as the cartoon colonel and at the other end they were the Mrs Thatchers. I think they're nothing you can put your finger on with great accuracy, but they were people who expected everything to work the way that it always had who thought that authority was best, who took a pretty mean line with anyone that questioned it, especially if the people that questioned it came from a similar background[39].

Despite this rather vague description, further discussions with Morgan-Grenville in addition to his own writings (Morgan-Grenville 2001), provide the sense that his version of 'Establishment' refers to the agents of political and economic *authority*. What is contradictory about Morgan-Grenville given his background and what is wholly significant to the biography of CAT founder is a notable anti-authoritarian sentiment, an inclination shared by those of the counter-culture with which he engaged prior to and vicariously through the establishment of CAT. For Morgan-Grenville and the wider modern environmental movement, given its policy for economic growth through aggressive industrialism it was "*counter* to the interests of the people"[40]. Furthermore, as a product of this authority, itself operating under the autonomy of the technocratic age, in addition to the potential destruction it could reap, nuclear technology represented the antithesis of the principles of decentralised self-governance. As Morgan-Grenville explains:

> I think what I thought about nuclear was that it was being sort of powered by an authoritarian government at the time and by an Establishment that backed that

[39] *Ibid.*
[40] *Ibid.*

> government and I think I was, partly as a function of age and at a time when the nuclear thing happened, anti-authoritarian so even if nuclear power had been a good thing it was the opposite of people power[41].

For Morgan-Grenville at least, the linkages between nuclear technology and what he viewed as an authoritarian society worked to further his conviction against the technology in favour of that which was small-scale, simplified and significantly people-powered.

As previously stated, Morgan-Grenville recounts that he was positively influenced by the ideas of E.F. Schumacher during the period of gestation which preceded the birth of CAT. In *Small is Beautiful* (1973) Schumacher advocated simple and appropriate technological systems denouncing the complexity of modern technologies, which by virtue of definition included nuclear technology. Both the complexity and hence mystification of nuclear technology and its linkages to nuclear weaponry elicited suspicion in the minds of the modern environmentalists which although a part of, superseded their general antipathy to wider industrial technocracy. For these reasons it was central to the radical environmental ideology that Morgan-Grenville pursued. What the ideas of Schumacher and his contemporaries provided for Morgan-Grenville was the idea that there might be an alternative to nuclear power; an idea which appealed to him and which gathered force the more he considered it[42].

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[41] *Ibid.*
[42] *Ibid.*

Prior to the development of CAT, Morgan-Grenville's environmental activism manifested itself through his involvement with an international environmental campaign called *Ecoropa* which was mobilised around the issue of nuclear technology. This was an ecological think tank set up by a leading Bordeaux wine merchant called Edward Kressman which had attracted a miscellany of disaffected Establishment individuals. Morgan-Grenville describes the organisation as "a totally informal grouping of leading environmentalists for lack of a better term" which operated throughout Western Europe[43]. Morgan-Grenville states that he had become involved with the group through people he'd met at conferences he had attended. Although he fails to recall the identity of these individuals or at which conferences he met them, he describes the group as a network of individuals which shared an anti-nuclear sentiment. Morgan-Grenville recalls that the group "met occasionally and decided what the issues were and how we were going to query them and it was left to the people, representatives of each country to decide and for my part I decided that a leaflet campaign was what was needed"[44]. With the help of what Morgan-Grenville describes as dissident nuclear physicists, Ecoropa printed a powerful anti-nuclear leaflet (Morgan-Grenville 2001). Of the anti-nuclear campaign Morgan-Grenville recalls that "we sold many millions of these leaflets and they were distributed very effectively up and down the country by little piles on counters in pubs, post offices, doctors surgeries, you know and you could talk to people anywhere and ... these leaflets were sort of 'nuclear power: the facts they don't want you to know' and there was a lot that they didn't want you to know and consequently it was very penetrative

[43] *Ibid.*
[44] *Ibid.*

as a leaflet"[45]. This 'bottom up' approach was typical of Morgan-Grenville's *active* environmentalism which favoured 'people power' over a 'top-down' policy, so typical of the authoritarian societal framework to which he was opposed. The CAT project was thus the product of a combined environmental and anti-authoritarian sensibility.

Despite his obvious discomfort with his class-determined position in life, it was this very aspect which, quite literally, afforded the founder of CAT the freedom to explore and develop his own interests through the ability to procure private funds to finance the venture. Morgan-Grenville's half brother Robert (eight years his senior) lived on the Kenyan coast at Malindi, at that time spending much of his time fishing after having been forced to leave the land he farmed in the Aberdare hills of Kenya at the time of the Mau-Mau insurrection (1952-1960). Morgan-Grenville recalls that his older sibling demonstrated his own expression of environmentalism through a concern for the fish stocks from which he took his own personal quota. Although he barely knew his half-brother, armed with a sense of the kind of person he might be Morgan-Grenville wrote to him to request funds for his project. Sympathetic to his ideals, Robert willingly offered the half-brother he barely knew £20,000 to fund the venture[46].

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[45] *Ibid.*
[46] A slate plaque honouring Robert Morgan-Grenville and his donation now adorns the outside of the Centre's restaurant building.

6.2.3 Place and Purpose: The Cultural Landscape of mid-Wales

Having secured the necessary funds, Morgan-Grenville embarked on the preliminary stages of creating his socio-environmental vision which began with the location of a suitable site. In his quest, the founder employed Steve Boulter, a post-graduate student of Boulder University, described by Morgan-Grenville as "a specialist in the study of ambient energy sources, such as solar, wave, wind, biogas and hydro" keen to become involved in a project in this field (Morgan-Grenville 2001: 159)[47]. Having heard about the site from the "Earth Workshop people"[48], Boulter subsequently located an abandoned slate quarry in rural North Wales. When asked about how Boulter located the site, Morgan-Grenville recalls that despite being "completely unpredictable as a person and basically hopeless ... he had this extraordinary quirky thing to turn up in the right place at the right time and he turned up in Machynlleth and met the Beaumonts ... which in the general order of things, is extraordinary, and persuaded them that this disused slate quarry they would do very well to make it over to us for experimental purposes"[49].

Located just off the main trunk road three miles north-west of the North Wales market town of Machynlleth, Llwyngwern Quarry was a seven acre plot in mid-Wales on the southern border of the Snowdonia National Park boundary. The site of a former slate quarry which was closed in 1951 after a fatal industrial accident, it had

[47] Boulter and Morgan-Grenville subsequently became estranged through a dispute over pay. Boulter returned to the US in 1974 to pursue other interests after it became apparent that his involvement with the CAT project had been irrevocably severed (Correspondence, CAT archive, CAT).
[48] Boulter, S., 1974, 'AT goes boom', *Undercurrents* 7, 4. See below.
[49] Gerard Morgan-Grenville, interview April 2007

since lain abandoned and disused[50]. The site constituted a five acre plateau, on which stood several dilapidated buildings surrounded by vegetated hillsides. Having been given directions to the foot of the quarry by Steve Boulter, Morgan-Grenville recalls his first visit to the site with his friend Diana Brass[51]:

> We parked the car and emerged into silence, broken only by the murmur of a stream. Above us a precipitous bank of slate rubble rose to a line of trees. To one side was a tangle of wild rhododendron: into this led the track.
>
> It took some time to clamber over or under the branches up the steep track. They ceased abruptly as we arrived at a broad and level expanse of slate waste dotted with birch trees. Beyond, the face of the quarry rose sheer to the grass covered hills above. There was a perfect stillness.
>
> We found a terrace of three ruined cottages, two huge derelict slate cutting sheds complete with rusted slate guillotines, several small flat-bed rail trucks and here and there, lengths of rail. Vast chunks of slate lay scattered around us, drill holes on one side where they had been exploded away from the rock face. Elsewhere were piles of half-finished or broken slabs of pigeon-grey slate, marble smooth and sharp-edged.
>
> We walked along the bed of a railway line, the rails partly vanished. It took us up to the lip of this vast heap of spoil extending out toward the green valley far below. Beyond were the tree covered slopes of the Mynydd Du mountains in the Gwynedd National Park. There was not a building in sight, just thousands of acres of sheep-dotted

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[50] Visitors Guide 1975, CAT Archive. See also Richards (1995)

[51] Entries in the 1974 project diary (CAT archive, CAT) and an interview with Roderick James reveal that Diana Brass played an integral role in the refurbishment of the site and development of the project. Diana was one of the otherwise anonymous authors of the project diary after Mark and Mary Matthews left the project. Roderick James also revealed that she was largely responsible for cooking the majority of the communal meals shared at Tea Chest. She later died of an Anorexic condition (Roderick James, interview April 2007).

grassland, moor and forest. It was a sensational view yet the quarry itself was hidden from the valley. We scampered back to explore the cottages. Though now the residence of numerous worms, beetles, mice and birds, I thought at least one could be made habitable quickly, ignorant as I then was of the annual rainfall of ninety-five inches (Morgan-Grenville 2001: 160).

These impressions of the site were articulated earlier in a twenty year anniversary publication of the Centre (Harper 1995)[52]:

In those seemingly far off days the place was something of a jungle, scattered with ruinous buildings from which birch trees grew in profusion. The golden leaves were falling slowly in the still air and the sense of timelessness with which I have always since associated this place, struck me forcibly. In such seclusion so far from the pressures under which most people live, I had the feeling that something new, some fresh and saner way of living might be demonstrated. My search for such a site had bought me to this beautiful and private place (Gerard Morgan-Grenville in Harper 1995: 5).

From these recollections two main observations can be drawn; firstly regarding the physical nature of the site which is further illustrated by two photographs (depicted in figures 6.2.3a and 6.2.3b) taken around the time of Morgan-Grenville's visit. Figure 6.2.3a looking east from the plateau of the quarry captures the despoliation of the site from discarded slate and thus the scene with which they were confronted on arrival.

[52] The 'National' prefix was later dropped and the project became simply the Centre for Alternative Technology.

Figure 6.2.3b captures more evidently its dereliction, ruined buildings and the degree of wilderness, scenes of abandoned industrial landscapes which echoed the kind of human landscapes that the counter-modern environmental movement valued and sought to re-instate through a connection to earlier, human-scale modes of production. The site also accommodated a reservoir perched above the plateau from which water had been used to power industrial processes associated with slate mining and a small narrow gauge railway which had once connected the site with Machynlleth, three miles north of the quarry. To consider this prior industrial use further, the history of the site as a place of heavy industry, one which had previously incorporated renewable methods of energy production, therefore lent itself to re-industrialisation as site of energy production. It would seem that place and purpose were historically and intimately linked at Llwyngwern Quarry.

Secondly, these memories convey a sense of the sites ambience and character. The site was heavily wooded and thus completely concealed from the road from which it was approached. This visual concealment contributed to its particular character and sense of place derived from its isolation. An overwhelming impression of tranquillity is conveyed; a space untouched by humanity for decades; a space reclaimed by nature. The sense of timelessness, simplicity, proximity to nature; a landscape created from itself and a sense of harmony between the buildings and the landscape combined to bestow on it a particular quality which resonated with the eco-philosophy of the project.

Figure 6.2.3a View from Llwyngwern Quarry looking east from the plateau of the site, c.1973
Source: National Library of Wales

Figure 6.2.3b Dilapidated buildings at Llwyngwern Quarry, c.1973
Source: National Library of Wales[53]

[53] These photographs were donated by CAT to the National Library of Wales. Neither of the images is dated, but given the closure of the working quarry in 1951 and the commencement of refurbishments on site in early 1974 they must have been taken somewhere between these dates, probably nearer the latter date and probably taken by Morgan-Grenville or someone otherwise directly involved with the project at an early stage.

This resonance was also reflected in the wider surroundings: This was a distinctly remote and rural place, nestled in a ruralised landscape characterised by small settlements and industries. The role these qualities played not only in the recognition of the site as an ideal location for the development of a working demonstration of renewable energy but also in its eventual success was integral. In its rejection of the complexity and sophistication of modern technologies, AT philosophy connected to notions of rural landscapes through ideas of 'traditional' industries and non-mechanised, simple technologies. The rural Welsh landscape also connected to the wider eco-philosophy of the AT movement through its relative absence of symbols of modernity and semblance of a more 'traditional' landscape: this area of the country demonstrated a high proportion of rural landscape, characterised by small-scale settlement patterns and a greater proportion of primary industries which facilitated closer engagement and communion with nature. This unique sense of place that Morgan-Grenville witnessed on first experiencing the site must have chimed so resonantly with the unique purpose he had in mind.

What also connected this particular locality to the ideology of the Centre was its comparatively economically underdeveloped state. Bob Todd, the first Technical Director of the project (see chapter 7) reveals that mains electricity was only implemented in the region in 1956 which was relatively late compared to more central and populated areas of Britain[54]. According to Todd, in the 1970s the local town of Machynlleth was powered by its own hydro-electric station which provided 60kW for the whole of the town. Local settlements such as the hamlet of

[54] Interview with Bob and Liz Todd, November 2005. The National Grid was constructed in 1926 (see Luckin 1990).

Pantperthog located at the foot of the Llwyngwern Quarry had its own 15kW water turbine which provided electricity for the school house and the old mill building. Local farms in the area were also self-sufficient producing electricity from individual turbines. The location for the project was therefore uniquely placed given an established tradition of energy self-sufficiency and technological primitiveness. However rather than a self-imposed or self-conscious decision to shun modern technology, this was borne out of an economic and cultural inertia as a result of geographical location. Given the peripheral nature of the mid-Wales region it can be argued that this was a function of its geographical marginality, a notion previously recognised and explored in connection to Wales by cultural geographers such as Denis Linehan (2003a; 2003b). This was not a phenomenon unique to Wales as witnessed by Hayden Lorimer (1997) who in his historical study of the cultural politics of the Scottish Highlands found that the region also suffered economic and cultural inertia on the grounds of geographical marginality.

The qualities of this unique space in its lack of modernisation symbolised the fundamental message of AT and reflected its rejection of the complexity, sophistication and alienation of post-war modernity. This detachment from everything that was synonymous with the city as a symbol of modernity resounded with the purpose for which Morgan-Grenville intended to employ the derelict space. In a twenty-fifth anniversary publication of the Centre (CAT 2000), Morgan-Grenville attests to this assertion and directly attributes the unique remoteness and special character of the site to its ultimate success. For Morgan-Grenville the term 'remoteness' seems to work as a euphemism for distance from major urban centres: He later recalled that in its 'remoteness' from what he calls 'the centres of population', it seemed ideal (Morgan-Grenville 2001). Morgan-Grenville described the essence of the location as "a spirit of peace, but also of purposefulness" with no "doubt that it has played a significant part in our achievements" (Morgan-Grenville in CAT 2000: 2).

Morgan-Grenville was not alone in his recognition of the qualities that rural Wales offered. From the early 1970s, the region became a geographical focus for the commune movement which witnessed a cultural exodus to the region and a place more generally for the practical expression of alternative cultures[55]. Morgan-Grenville's recollection was that "there were lots of people who had dropped out who were living in Wales at the time" with whom Morgan-Grenville affiliates himself thus: "I mean it has to be said that we were considered Hippies or neo-Hippies"[56]. Other contemporaneous notable 'alternative' projects in the region included the Biotechnic Research and Design centre (BRAD) near Churchstoke in Montgomeryshire, Earth Workshop at Llanddeusant near Llandeilo and TePee Valley both in Carmarthenshire[57]. The establishment of these projects facilitated the growth of the region's wider alternative community, and indeed its *character*, as many individual householders (and similar

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[55] For a deeper exploration of this movement, specifically the establishment of 'alternative' communities see Halfacree (2006).

[56] Interview with Gerard Morgan-Grenville, April 2007

[57] According to Peter Harper, Earth Workshop was instituted by a group of people loosely associated with the Architecture Association of the Bartlett School of Architecture in London. Harper commented that it "could have worked because it had an income stream from running the Youth Hostel. But like so many of these communities, it imploded in the late 1970s through an insufficient appreciation of the fragility of human relationships and the need to maintain reasonable levels of both decorum and income" (Email correspondence from Peter Harper, December 2005). Another experimental community in the region included the New Villages Association which sought to experiment with alternative visions of communities through a co-operative land trust (Bob Todd, interview November 2005).

organisations) made the pilgrimage to mid-Wales[58]. This observation is both supported in and reflected by a book published to accompany a regional television series by the same title which explored the institution of this counter-culture in Wales from the 1970s. *Alternatives* (Osmond and Graham 1984) explored the various manifestations of the new counter-culture which the authors state found expression through alternative approaches to health, education, family and community as well as energy and the natural environment. Incidentally, the front cover of the book displayed a photo of the Cretan windmill built by CAT, its first energy generator (see figure 7.1.6).

In light of these other official and unofficial projects and communities it is entirely unsurprising that the Centre developed in the location that it did. It is perhaps for these reasons that Steve Boulter was drawn to the region in his quest for a suitable site. When asked about how or why Boulter had ended up in Wales, Morgan-Grenville was unable to provide a conclusive response. However the reputation of the region as one characterised by "back-to-the-land neo-primitivism"[59] of the 1970s and the fact that Boulter had heard about the site through Earth Workshop is sufficient to draw connections between the developing alternative cultural character of the region and the establishment of an exhibition of alternative technology, itself affiliated to the alternative cultural movement and conclude that it was neither coincidental nor accidental. In the way that it was increasingly populated by a sub-culture unified in its search for an alternative way of life and characterised by a sense of community and simple living, the region

[58] The Tepee Valley community was officially established in 1976 when farmland was purchased for the initial purpose of extending the music festival season through creating a long term community (Halfacree 2006).

[59] Peter Harper, email correspondence, November 2005

can be compared to the San Franciscan Hills visited by Morgan-Grenville in the late-1960s. The physical features of the mid-Wales landscapes previously described were evidently a strong attraction for this particular (counter)cultural orientation.

Like CAT, these other experimental communities (and individual households) often attempted to incorporate self-sufficiency in varying degrees and methods. This pursuit and the region to which such groups were drawn was undoubtedly influenced by the activities and subsequent publications of the self-sufficiency 'guru' John Seymour who had himself re-located his activities to the region[60]. In considering this re-location the availability of large tracts of land must undoubtedly have been a factor in this decision, however, rural Wales was the antithesis to 'the city', the geographical focus for the industrial society to which the movement was ideologically opposed. Seymour, in line with contemporaries such as E.F. Schumacher, advocated a return to a societal system in favour of 'self-reliance' over 'organisation' (Seymour 1976). Educated at agricultural college and having subsequently earned a living through various agricultural positions including managing a sheep and cattle farm and acting as livestock officer for a government department, both in Africa (*ibid.*), John Seymour became a 'smallholder' initially in Suffolk, and later on a 62-acre farm in Pembrokeshire, which was developed as an educational institute where interested parties could learn how to be (agriculturally) self-reliant. Seymour first published his self-sufficiency expertise in 1961 in *The Fat of the Land* (Seymour 1961) followed by two further publications on the subject in 1973 (Seymour 1973) and 1976 which

[60] Peter Harper, interview November 2005; Gerard Morgan-Grenville, interview April 2007

included a foreword by E.F. Schumacher and was to become known colloquially as the 'bible of self-sufficiency' for many communards and individuals (Seymour 1976)[61]. The role the activities of John Seymour played in precipitating this cultural exodus is inconclusive. However, anecdotal evidence suggests that it was influential in stimulating a cultural movement to the landscapes of rural Wales in pursuit of this kind of lifestyle.

Despite the fact that Morgan-Grenville consciously sought a site "away from a major town"[62] for ideological reasons 'remoteness' also played a more fundamental role in the search for a suitable site. Part of the AT philosophy, according to Morgan-Grenville, was decentralisation, therefore a rural site away from large urban centres accorded with this ideal. Not only did the quest for remoteness and isolation reflect a desire to be separate from mainstream society it also masked a more fundamental motivation. AT theorist and later CAT employee Peter Harper describes a genuine fear of nuclear attack amongst certain cohorts of the radical environmental community who felt that it was a case of *when* rather than *if* Britain came under fire[63]. In the event of this inevitability, distance from a strategic urban centre would minimise the probability of being affected directly or by the aftermath. Not only was this a driver in the search for a site, it was also a wider stimulus for the development of AT in its ability to facilitate a self-sufficiency. The status of urban centres in Wales (in any case predominantly in the South of the country) as key targets in the event of a nuclear conflict was probably fairly low. Thus, this factor combined with the proportion of rural to urban land, meant that the principality was potentially yielding in the search for a

[61] Peter Harper, interview November 2005
[62] Morgan-Grenville, Powys County Council planning application number M15652
[63] Interview with Peter Harper, November 2005

suitable site for Morgan-Grenville's ecological vision. As he proposed himself, "Where better than this derelict but beautiful site to pioneer a way of life which could be lived without using up the capital resources of planet Earth or employing technologies that could be fatally dangerous to civilisation? (Morgan-Grenville 2001: 162).

Having decided on Llwyngwern Quarry as the ideal spot, the next stage in bringing Morgan-Grenville's vision to reality was to approach the landowner. Fortuitously for Morgan-Grenville, the site was owned by local landowner and fellow former Etonian, John Beaumont. The Beaumonts had lived in and around Machynlleth for several generations having married into the Londonderry family in the early twentieth century[64]. The family benefited from considerable land and property ownership in the local area including Plas Machynlleth, a large house in the middle of the town which, dating back to the 1600s had been the seat of the Londonderry family for several generations. In 1874, the famous clock tower in the town was built by the people of Machynlleth to mark the coming of age at twenty-one of Charles, the sixth Marquis of Londonderry and ancestor of John Beaumont[65]. Beaumont had purchased the quarry site not long prior to meeting Morgan-Grenville with the intention of developing it as a commercial enterprise of some sort[66]. Given his historical connection to and thus embeddedness within

[64] Interview with Audrey Beaumont, November 2005

[65] *Ibid.*

[66] *Ibid.* In the summer of 1972, John Beaumont had submitted a planning application for the development of six 'Norwegian style' chalets as holiday accommodation on the site for which he had been granted planning permission but had hitherto failed to pursue the project (planning application number 13242, Planning Office, Powys County Council).

the locality, a vested interest in the future of the quarry site, flanked either side by agricultural land already owned by the family, is understood[67].

Morgan-Grenville describes his landlord as "outwardly a highly conventional man" clearly conforming to his social standing and class position (Morgan-Grenville, 2001: 160). However, he also recounts that Beaumont quickly understood and welcomed the project, apparently generously agreeing within an hour of meeting to a peppercorn rent of one shilling per annum for a one hundred year lease. The two were unacquainted during their respective schooling but clearly held common ground based on this shared experience and class membership of the land-owning aristocracy[68]. Morgan-Grenville and the Beaumonts also shared a certain sensibility for 'simple living': Audrey Beaumont had been raised in India in the last days of the British raj, but the couple had later lived in Africa for nineteen years where she recalls they'd managed happily with few basic amenities[69]. This common feeling subsequently induced a close and co-operative working relationship between the Beaumonts and the CAT pioneers in the early years of the project. Described in the first revamped issue of the Centre's newsletter *Clean Slate* (1989) as the "Fairy Godmother to the pioneers", the assistance Audrey Beaumont and her husband provided the CAT activists is evident in the 1974 project diary. Entries often record Audrey's willing assistance in the provision of food and accommodation for the centre staff and volunteers as well as congenial evenings (often coinciding with Morgan-Grenville's visits) spent under their (warm and dry) roof. This level of hospitality extended to the

[67] *Undercurrents* once described John Beaumont as the town mayor, although further evidence of this has not been traced.
[68] Since the twelfth century Stowe in Buckingham had been the Grenville family seat. In the 1920s it was sold and converted to a public school (Morgan-Grenville 2001).
[69] Audrey Beaumont, interview November 2005

refurbishment of the Beaumont's downstairs toilet for Prince Philip's personal use on his visit to the Centre in 1974[70].

Although in retrospect Llwyngwern Quarry corresponded so perfectly to the purpose of the proposed project, the founder stated that the only real criterion for Boulter's search for a site was somewhere that would gain planning permission. Scotland had been excluded on grounds of geographical distance from London, leaving England and Wales as the search area[71]. Morgan-Grenville recollects that he was of the opinion that convinced of the allure of alternative technology and aware of the cultural zeitgeist "even if it's very cut off ... if you've got a good enough thing, saying an interesting thing, people will come to you"[72].

6.2.4 The Planning Framework: Re-industrialisation, Scale and Visibility at Llwyngwern Quarry

Having secured the lease of the quarry from a landowner sympathetic to his environmental vision, the next step towards making this vision a reality was to obtain planning permission. According to Powys County Council's archived planning documents from the period, in November 1973, Morgan-Grenville submitted two initial applications. The first, regarding the creation of the Centre itself, sought permission for the development of a Research Establishment to "develop, research, construct, erect, test and demonstrate appliances in the field of Alternative Technology"[73]. The second sought permission for the restoration and

[70] *Ibid.*
[71] Gerard Morgan-Grenville, interview April 2007
[72] *Ibid.*
[73] Powys County Council planning application number 15652. Explanatory Note B, paragraph b

refurbishment of the existing buildings on site[74]. Morgan-Grenville approached the planning process under the impression that it was the "hardest thing to find within Britain any site on which planning permission would be given for some experimental and unorthodox venture. At the first whiff of the unconventional or the politically controversial, most planners run a mile" (Morgan-Grenville 2001: 159). For this reason, aware of the unusual nature and what he describes as anti-Establishment rhetoric of the project, Morgan-Grenville decided that what he needed was a conventional front, with both a respectable patronage and a moral purpose. He subsequently established the Society for Environmental Improvement (SEI), which held environmental and social education as its prime objective and served as the funding body for the CAT project[75]. Morgan-Grenville recalls that within the space of a month he had attracted the financial and theoretical backing of a dozen or so 'nationally respected individuals' (Morgan-Grenville 2001). One of these supporters was Roy Jenkins. Morgan-Grenville records that his meeting with the politician was suitably brief; just long enough for Jenkins to relay that so far as he was not required to devote time or money he was happy to patronise the venture. At the time Morgan-Grenville approached him, Jenkins was Home Secretary for the Labour Government a position he had previously held in 1964 with the election of the Wilson Government. He subsequently occupied positions as Chancellor of the Exchequer and Deputy Leader of the opposition Labour Party between 1970 and 1972. Peter Parker, then chairman of British Rail had

[74] Powys County Council planning application number 15685

[75] Although SEI was initially created purely as a holding company through which to channel the funding for the project, it later acted for other environmental interests which Morgan-Grenville pursued. On being asked about other projects with which SEI was involved, Morgan-Grenville simply stated that none were as significant as CAT (Gerard Morgan-Grenville, interview April 2007).

also agreed to patronise the Society[76]. No further recollections regarding the list of people could be made other than the fact that it consisted mostly of "academics and business people and politicians"[77], notably characteristic of the 'Establishment' from which Morgan-Grenville so fervently sought to differentiate himself (see chapter 7).

Morgan-Grenville was clearly conscious of the connections of AT to the Hippie counter-culture and the potentially adverse connotations this could have in the application process, hence his decision to include a list of impressive 'Establishment' patronage. However, given the absence of supporting planning-application material, the importance that this superficial credibility played in the decision-making is indeterminable. As a clearly well-educated individual, Morgan-Grenville's lengthy explanatory notes to the planning application undoubtedly conveyed a sense of knowledge and authority as the project's founder. It is unlikely that this, along with the list of impressive advocacy that Morgan-Grenville had hastily but successfully assembled failed to register with the planning committee. However, despite Morgan-Grenville's anticipated difficulty in gaining planning permission, which may explain the protracted justification to the application in the form of the explanatory notes, after a site visit by the Planning Inspection Sub-Committee, permission was granted subject to "submission and approval of detailed plans of any new buildings, structures or alterations to existing houses and buildings"[78]. Other than this standard planning decision-making practice, evidence would suggest a particularly passive decision-

[76] Gerard Morgan-Grenville, interview April 2007
[77] *Ibid.* Although the planning application claims to include a copy of this list, it is now missing and there is evidence to suggest that it was never included with the original application.
[78] Powys County Council planning application number 15652

making procedure, thereby contradicting Morgan-Grenville's expectations of an adversarial process. To support this assertion the planning documents also record an absence of representations against the proposal[79]. Although this is inconclusive evidence for a lack of objection it carries some significance. This local neutrality towards the application could be understood in terms of the economic depression of the region due to the decline of the local slate mining industry potentially giving rise to a situation whereby any proposal, regardless of its commercial or industrial nature might have been welcomed for consideration at this juncture.

Despite a dearth of planning decision material, secondary sources provide an insight into the wider planning policies applicable to the decision-making process. At the point of application, just prior to local government re-organisation in England and Wales in 1974, the relevant planning guidance was articulated in the local development plan, relevant to the administrative area in which Llwyngwern Quarry existed which prior to local government reorganisation was Montgomeryshire (see Montgomeryshire County Council 1951)[80]. Development plans were introduced with the 1947 Town and Country Planning Act. Administrated by the county authority they were designed to provide the wider planning strategy for the locality, in other words to constitute a 'public declaration of the local planning authorities' intentions' (Cullingworth 1980). National planning legislation (which would have been relevant in Montgomeryshire and which may have been incorporated into the local development plan for the area) was also outlined in the Town and Country Planning Act 1968. Interestingly, this

[79] *Ibid.*
[80] It is likely that this document would have been updated between 1951 when it was published and 1973 when Morgan-Grenville first sought planning consent for the Centre, but no such article has been traced.

planning guidance specifically encouraged the re-use of derelict industrial land especially those sites previously used for mineral works, stating that such sites should "(wherever practicable) not be left derelict but 'restored or otherwise treated with a view of bringing it back to some form of beneficial use'" (Cullingworth 1972: 190). This evidence therefore suggests that the local planning authority deferred directly to national planning legislation. According to the Hunt Committee[81] the underlying rationale was that an unfavourable environment depresses economic opportunity: dereliction "deters the modern industry which is needed for the regeneration of those areas and helps to stimulate outward migration" (Hunt Committee in Cullingworth 1976: 168). According to primary and secondary sources the economic impact of the decline of slate quarrying in the region had certainly been felt and perhaps more acutely around Machynlleth than elsewhere: according to the Centre's 1976 *Visitors' Guide*[82], Llwyngwern Quarry, unlike neighbouring quarries which were more reliable, yielded an unpredictable product: Llwyngwern slate was brittle and unsuitable for reliable slate markets such as roofing tiles. Given this predilection, the quarry had often been on the verge of bankruptcy causing ownership to change hands frequently. Privy to this knowledge the local planning authority may have considered the re-industrialisation of the site as something other than a slate mine, which had previously proved economically problematic, a preferable option. In accordance with the environmental philosophy of the project and undoubtedly well versed in the relevant planning guidance, Morgan-Grenville drew on the re-

[81] "The terms of reference to this Committee were 'to examine in relation to the economic welfare of the country as a whole and the needs of the development areas, the situation in other areas where the rate of economic growth gives cause (or may give cause) for concern, and suggest whether revised policies to influence economic growth in such areas are desirable and, if so, what measures should be adopted'" (Cullingworth 1976: 238).
[82] CAT Archive

use of "useful service areas of land" in support of the planning application[83]. Given existing industrial works in the form of a railway and system of water-power, features of the site that Morgan-Grenville proposed to restore to working order, the prospect of re-industrialising the site in a way that was both sympathetic to the surrounding landscape and which re-used surviving industrial remnants[84] must have seemed a relatively unthreatening option to the planners, especially as a venture with the potential to boost the local economy through visitor attraction. Regardless of the planning authority's specific rationale, the re-industrialisation of serviceable areas of land was evidently a priority within wider national planning strategies which bore relevance to this application. Other slate quarries in the vicinity namely the Llechwedd quarry and Gloddfa Ganol quarry[85] which had both closed in the 1970s had subsequently undergone similar diversification into the leisure and tourism industry by similarly remodelling the remnants of the quarries into visitor attractions[86]. Thus, the general planning policy to redevelop otherwise derelict mineral workings was being actively employed in the Snowdonia National Park and its environs.

To consider the planning application further, although Llwyngwern Quarry was located just outside the border of Snowdonia National Park, issues of visibility remained pertinent, an aspect Morgan-Grenville cites directly as a criterion for the location of a potential site stating that "planners would look on this thing more favourably if it didn't spoil the view"[87]. Despite an absence of commentary in the

[83] Explanatory note A, Powys County Council planning application number 15652
[84] Paragraph 7 of Explanatory note A (Powys County Council planning application number 15652) stated the existence of sources of ambient power and usable buildings as supporting evidence.
[85] Formerly the Oakeley slate quarry
[86] Local Planning Officer, Powys County Council, informal discussion November 2005
[87] Gerard Morgan-Grenville, interview April 2007

planning minutes, issues of visibility, at least for Morgan-Grenville, were a potentially obstructive factor to the success of the application; sufficiently so for the applicant to draw on the quarry's concealment from view of the surrounding landscape in the supporting material to the application[88]. Negative reactions to the development of industrial sites within National Park areas, for example the Trawsfynedd nuclear power station in neighbouring Snowdonia illustrate the importance of maintaining landscape harmony within these designated areas (see Cullingworth 1975), an aspect of local planning guidance that was illustrated through later correspondence between CAT and Powys County Council. A planning response to an application for the construction of six chalets on site in December 1978 suggested that the proximity of the site to the National Park boundary and also its visibility from the bordering A487 were determining factors to the planning decision[89]. It was suggested by the Chief Planning Officer that the proposed chalets, if permitted, should be concealed through an extensive tree planting scheme or better still the integration of the proposed location of the chalets into the main site of CAT from where it would no longer be visible from the A487 which served as the National Park boundary. Evidently these issues were pertinent and the concealment of the quarry site from the view of the road and therefore the National Park boundary potentially negated issues of visual blight contributing to a successful planning application. Even structures that may ordinarily have been considered 'industrial' in character received planning permission which may also have resulted from their concealment from view of the surrounding landscape. Two experimental wind turbines, one reaching thirty feet in height (see figures 7.1.5 and 7.1.6) were granted planning permission in

[88] However, it is important to note that the impetus to re-develop the site may have been low given the existing concealment of the quarry from the surrounding landscape.
[89] Powys County Council planning application number M5814

1976, subject to having a "lightish grey matt finish" thus confirming the importance of landscape harmony within the local planning framework[90]. Although emphasis was placed on the redevelopment of land, this was not to be at the expense of visual amenity particularly in designated areas or those close to their borders. Landscape harmony within the local planning framework was therefore of the utmost importance to be maintained through delicate but specific negotiation. There was thus a careful balance to be struck between re-industrialisation (and thus economic regeneration) and the maintenance of landscape harmony in 1970s Welsh planning discourses.

Planning permission for the CAT project was granted in March 1974. The strategy was to establish a visitor's centre, but also as an autonomous community where those working at the Centre would also live communally on site. Morgan-Grenville intended to remain living off site at his home in Surrey from where he would direct activities, a process which incorporated reflexive negotiation of its specific aims and objectives with the site community, aspects of the project's functioning which are explored in depth in chapter 7.

6.3 Conclusion

The first part of this chapter has considered the contextual history to the counter-modern environmental movement through which the relationship between the natural and human worlds was re-envisioned. Part of this new vision necessitated a re-evaluation of technology and its relationship to society and the natural world.

[90] Powys County Council planning application number M2284. See chapter 8 for deeper consideration of these images.

The Centre for Alternative Technology, a pioneering and unique project in the field of alternative energy technologies, represents the first example in Britain of practical engagement with the emerging socio-environmental philosophies discussed throughout this chapter. Furthermore, CAT represents the first engagements with 'renewable' energy technologies as they have come to be conceptualised through the environmental discourses of the late-twentieth century. Although, as previous chapters have demonstrated, the provenance of electricity generation from naturally renewing resources can be traced to the late nineteenth century, it is only within recent decades that the concept of 'renewability' in the context of energy generation has gained discursive power.

As discussed in chapter 1, part of the research proposition of the thesis is to consider hitherto unexplored engagements with renewable energy technologies. This was addressed in Part I through the exploration of the first examples of hydro-electricity as 'modernising', civic projects which implemented the latest developments in late-Victorian electrical engineering technologies and which significantly, looked to the future as a means of social and technological progression, and which embraced notions of increasing complexity, whilst material and conceptual ideas of nature were positioned firmly as subordinate and *othered* to humankind, a resource to be 'rationalised', reflecting late-Victorian environmental sensibilities of 'economy' and 'order'. In contrast, Part II considers the renewable energy technologies pioneered at CAT a century later. These engagements sought to embrace and restore simplified technological practices as a rejection of the omnipotence of the technological complexity which in the opinion of the counter-modern environmentalists had come to dominate the social and environmental worlds. Socio-environmental visions of the post-war era also sought to restore the bonds between nature and humankind, placing humankind firmly *within* nature. However, akin to engagements with renewable energy technologies a century before it, the scope of CAT's vision, as an exercise in self-sufficiency was, necessarily *local* and small in scale and like late-Victorian hydro-electric projects sensitive to and informed by the industrial history of the local landscape.

Despite these echoes, the renewable energy projects of the 1970s were borne out of a wholly different technological and environmental expression which, as outlined above, rejected the values that had, in their more embryonic stages, fostered the development of their late-nineteenth century counterparts.

7 Alternative Visions in Practice: The Workings of the Centre for Alternative Technology

Having considered the prelude to the establishment of CAT the phase in which the physical manifestation of the Centre was instituted in now considered. Taking a predominantly thematic approach, interspersed with details of the chronological developments on site, this chapter, through an exploration of the technical and social objectives of the project delineates the wider modern environmental ideologies manifest at the Centre. The chapter first continues however by providing a vignette of the work undertaken at Llwyngwern Quarry during its embryonic stages by way of introducing a sense of life on site.

The Centre for Alternative Technology opened its doors to visitors in July 1975. However, work had been underway on site since the autumn of 1973, not long after Morgan-Grenville's fist visit. In February 1974 after several months of work, Morgan-Grenville had appointed Tony Williams Project Manager, who with a handful of others had moved into caravans stationed in the car-parking area at the foot of the quarry[1]. After the initial clearance of the site, which involved the laborious tasks of shifting endless heaps of slate waste and hacking back the

[1] Of those living on site at the time, only Tony Williams is named specifically. Others are recognised on a first name basis only, appearing intermittently in the diary, with no mention of their arrival at or departure from the project (1974 and 1975 project diaries, CAT Archive). The diary, started in February 1974, functions primarily as a material artefact to the daily on-site activities.

overgrown vegetation, the first thing the CAT pioneers aimed to achieve was the refurbishment of the existing buildings to a degree of comfort which enabled habitation by the skeleton workforce[2]. This task constituted the bulk of the work and occupied those at the quarry for a large part of the proceeding year. Specific tasks included the refurbishment of the existing buildings encompassing the installation of new (alternative) technologies for the provision of the most basic amenities. The first form of AT installed on site consisted of a coil of copper tube in the fireplace connected to a radiator in the bedroom for the provision of heating and hot water[3]. In addition to addressing basic domestic requirements more project-focused tasks, specifically the restoration of the railway, were attended to often in adverse weather conditions which more often than not amounted to persistent rain[4]. This working environment is well-remembered by those on site whose enduring memory of this embryonic phase is one of "tumbledown buildings and a lot of tarpaulin trying to keep the rain out"[5]. These were evidently far from enviable circumstances, but the community's endurance of these conditions reflected a certain commitment to the project and the practical reality of the meagre domestic amenities that this necessitated. Despite the primitive conditions that the early CAT employees endured the early pioneers recall that they were secondary to the perceived commitment to a shared vision, something that was fundamental to the early progress of the project[6].

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[2] The arrival of seven volunteers is recorded on 5th February "which makes us twelve" (1974 Project Diary, CAT Archive).
[3] 9th March, 1974 Project Diary , CAT archive
[4] 1974 Project Diary , CAT archive
[5] Bob Todd, Interview with Bob and Liz Todd, November 2005
[6] Bob Todd, interview with Bob and Liz Todd, November 2005; Gerard Morgan-Grenville, interview April 2007.

7.1 Alternative Technology at CAT

7.1.1 Alternative Technology I: Bridging the Cultural Divide

Although on a day-to-day basis the project workers were practically engaged in realising the most immediate short-term goal of establishing basic amenities on site, the broader aims and fundamental purpose of the project and how best these might be achieved took longer to be worked out. A series of correspondences between Morgan-Grenville and the on-site community and other memoranda and documentation retained in the archive tell of a deep commitment to the project, but also of a conflict of interests about the exact nature of the project and the minutiae that might therein be entailed. Despite these conflicts, at the outset the ultimate aim of the project was a point of overall agreement.

The Centre's fundamental purpose was to bridge the gap between conventional and 'alternative' culture. Always mindful of the associations of AT to the marginalised counter-culture, Morgan-Grenville knew that in order to achieve this objective he had to find some way of bringing the ideas of the radical environmental movement to the consciousness of mainstream culture. As he saw it conventional society was unlikely to listen to the unorthodox claims of those who were essentially dismissed as Hippies. Aware of the connections his position in class-society afforded him, as someone who straddled the two worlds, Morgan-Grenville saw that his unique position could bridge the ideological and cultural divide. As explored in the preceding chapter, his familial and aristocratic connections had afforded him the freedom to explore and develop this kind of venture and the 'conventional front' that could appeal to, and critically, *avoid alienating* the wider public. The best way to do this, for Morgan-Grenville was primarily through the practical demonstration of alternative technology' through which the wider message of ecologism and its ideological tenets and hence the damage that industrial society had the potential to effect on both the human and natural environment could be communicated. In his words, Morgan-Grenville sought to send a clear message to those he sought to influence, whereby

> people, ordinary passers-by, might readily perceive the disastrous course on which our civilisation was set and be shown things they, *anyone*, might do to reduce their impact on the environment ... It was intended to show a range of practices which would have minimal adverse consequences both environmentally and socially (Morgan-Grenville 2001: 158).

The aim of the centre was not only to communicate this way of seeing the modern world, but through the demonstration of simpler technologies to provide a model of an alternative to conventional society which as he saw it could not offer "a valid existence"[7]. Morgan-Grenville saw this as a practical method of engaging people with the ecological problem faced by the world and demonstrating a way of achieving "a real chance for environmental sanity and human fulfilment"[8].

[7] Morgan-Grenville, n.d., 'Definition of our role at Llwyngwern Quarry', CAT Archive
[8] Outline plan for development at Llwyngwern Quarry, 1975, CAT Archive

Despite this clear purpose of the project, ideas about how it was to be achieved, at least during the developmental stages of the Centre were more reflexive, the initial stages of the project being characterised by an inchoate set of aims and objectives. The way Morgan-Grenville had thus far instituted the project with the establishment of an ostensibly egalitarian community meant that the specific aims and objectives of the project were in constant flux. To illustrate this, three outline descriptions of the project were produced in March, June and September 1974, with a further variation produced in early 1975[9].

The aim of the project according to these documents was to "encourage greater national self-sufficiency by showing less wasteful methods of living"[10] through "the employment of techniques which have minimal adverse consequences to the environment"[11]. Although the project aimed to place emphasis on the production and economical use of energy from renewable sources including (but not limited to) sun, wind, water and organic waste, the project also aimed to demonstrate "techniques for energy conservation and storage; intensive organic horticulture; community scale recycling and manufacturing systems, and other environmentally beneficial practices. An information service will also be established"[12]. Self-sufficiency was defined in these documents as "increased independence of 'imported' resources, the provision

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[9] The date of this document is hand written on the front of the document, possibly at a later point, and is therefore inconclusive. Although they are all dated differently there appears to be little differentiation between each document.
[10] Undated document headed 'National Centre for Alternative Technology and Resource Conservation, SEI', CAT Archive
[11] 'National Centre for Alternative Technology, November 1973, Godalming, Surrey: SEI', CAT Archive
[12] Undated document headed 'National Centre for Alternative Technology and Resource Conservation, SEI', CAT Archive

of which places an unjustifiable and sometimes dangerous strain on the environment"[13]. The alternative technologies that the project promoted in terms of helping to achieve this situation had to meet the following criteria: to demonstrate an energy benefit over conventional alternatives; be repairable locally and which were therefore inherently simple; be aesthetically pleasing; and demonstrate consideration for appropriate use of materials[14].

Despite these preliminary preoccupations with the aims of the project, work on the development of AT exhibits at the centre continued apace. By October 1974, the restoration work had been completed on various cottages on site including a built in solar collector on one of the roofs, the installation of a hydro-electric scheme and partial completion of an electricity grid[15]. The hydro-electric installation in particular was a significant development. In March 1974 a 60 year old Pelton wheel was purchased for the generation of hydro-electricity on-site[16]. A 4 inch pipeline approximately 200m in length supplied water to the turbine from the existing reservoir which, located 30m above the installation (see figure 7.1.3), provided 140 gallons of water per minute, producing 1-1.5kW of power. Coupled with a 2.5kW generator which had been bought as scrap, this system provided the main source of electrical power at the Quarry at least into the early 1980s[17]. Evidently, once the

[13] 'Outline plan for development at Llwyngwern Quarry', 1975, CAT Archive
[14] *Ibid.*
[15] 1974 Project Diary, CAT Archive
[16] 30th March 1974, Project Diary, CAT archive. Bob Todd recalls that the turbine was purchased locally in Machynlleth (the project diary records for a price of £7). It had been found scrapped behind a garage in the town. Todd states that the history of small renewables in the area resulted in a local availability of relevant technology (interview November 2005).
[17] Quarry Association Newsletter, Summer 1980, CAT Archive

initial stumbling blocks of establishing the exact nature of the project had been negotiated, the Centre evolved with less difficulty[18].

7.1.2 Alternative Technology II: Simplicity, Demystification and Self-Sufficiency

The exact nature of the technologies through which the project aimed to disseminate its ecological message ranged in scale and manifestation. The eventual exhibition would incorporate water powered energy technologies including small scale turbines, high efficiency waterwheels, a hydraulic ram and a small-scale pump storage; solar power technologies would consist of flat-plate collectors, focusing collectors, solar-electric conversion, solar-heat engine; wind power technologies would demonstrate a 'savonius rotor'[19], wind turbine, small propeller, large propeller and other experimental devices. The centre also planned to exhibit a methane digester for the production of gas, heat exchangers in the form of a heat pump and a domestic heat collector and the distillation of wood alcohol for other life essentials. The proposed layout of these installations was envisioned in a series of 'site plans' prepared mainly for submission with various planning applications. These 'site plans', which reveal not only the geographical extent and layout of the proposed project but also existing and proposed buildings and installations including the plan based on which planning permission was granted, are reproduced in figures 7.1.1 to 7.1.3. These images also

[18] This could be attributed to the arrival of new project manager around the summer of 1975 by the name of Roderick James. Mark Matthews who had been project managing up until this point had resigned due to a growing feeling of 'disconnection' from the project (Interview with Bob and Liz Todd, November 2005).
[19] This was a small windmill device used to generate electricity from wind power named after its designer the Finnish engineer Sigurd J. Savonius who invented it around 1925.

illustrate the evolution of the site over time. Figure 7.1.1 in conjunction with figures 6.2.3a and 6.2.3b demonstrates the sparse and undeveloped nature of the site in terms of human habitation at the outset of the project, whilst figure 7.1.2 reveals how CAT envisaged the nature of site after construction, which, as illustrated by figure 7.1.3 was eventually brought to fruition. The nature of this particular image reflects and communicates the wider ethos if the project as unregimented, accessible and human-faced.

In addition to these alternative technologies, other features of the project, as illustrated in figures 7.1.2 and 7.1.3, would include the recycling of materials, alternative building methods and materials, organic agriculture and horticulture and animal husbandry, environmentally benign transport technologies and alternative approaches to personnel systems and organisation. CAT also aimed to incorporate alternative methods of gardening and animal husbandry through organic agriculture and horticulture and ecologically efficient building technologies and techniques.

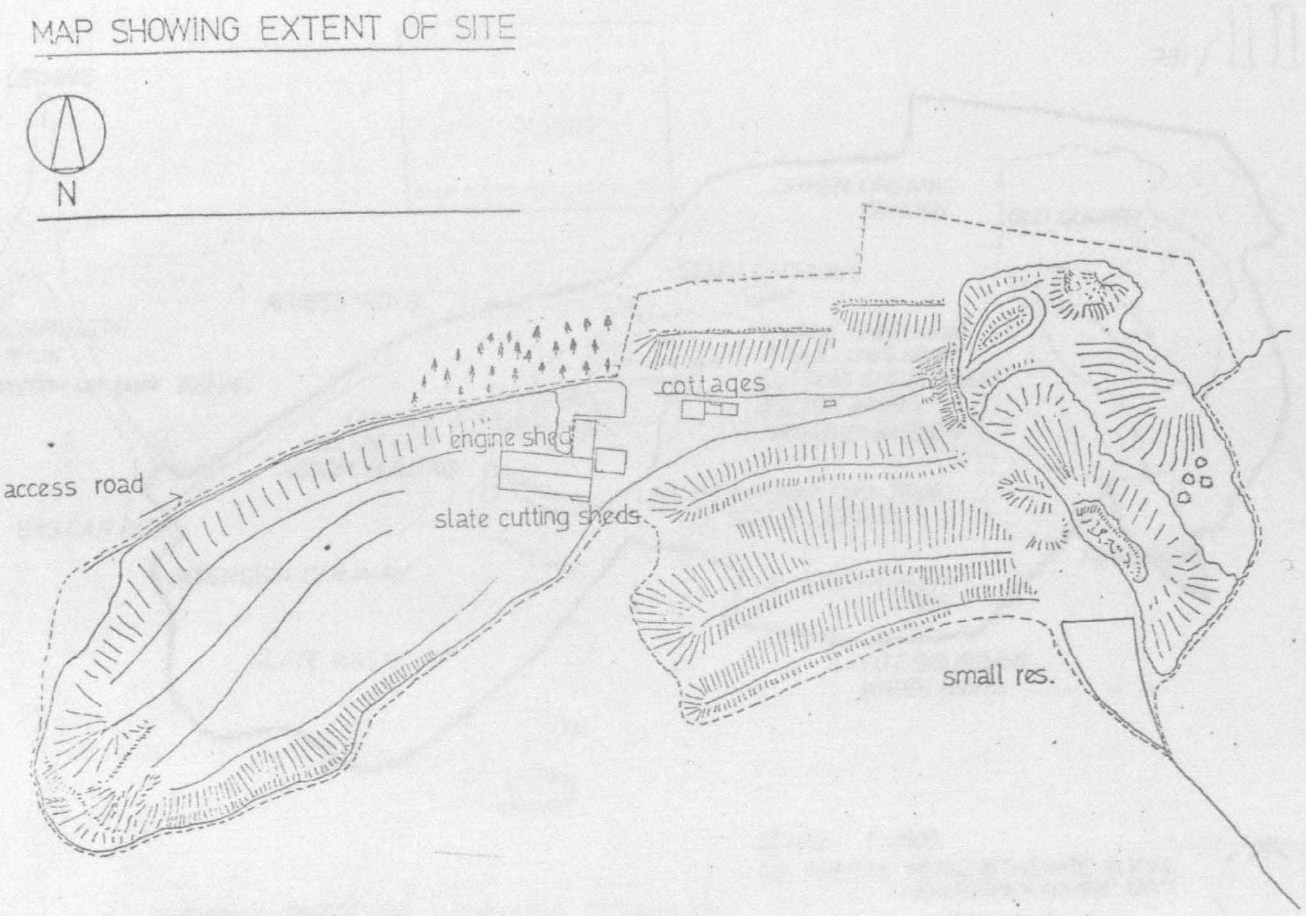

Figure 7.1.1 Plan of the existing site of Llwyngwern Quarry prior to construction
Source: CAT Archive

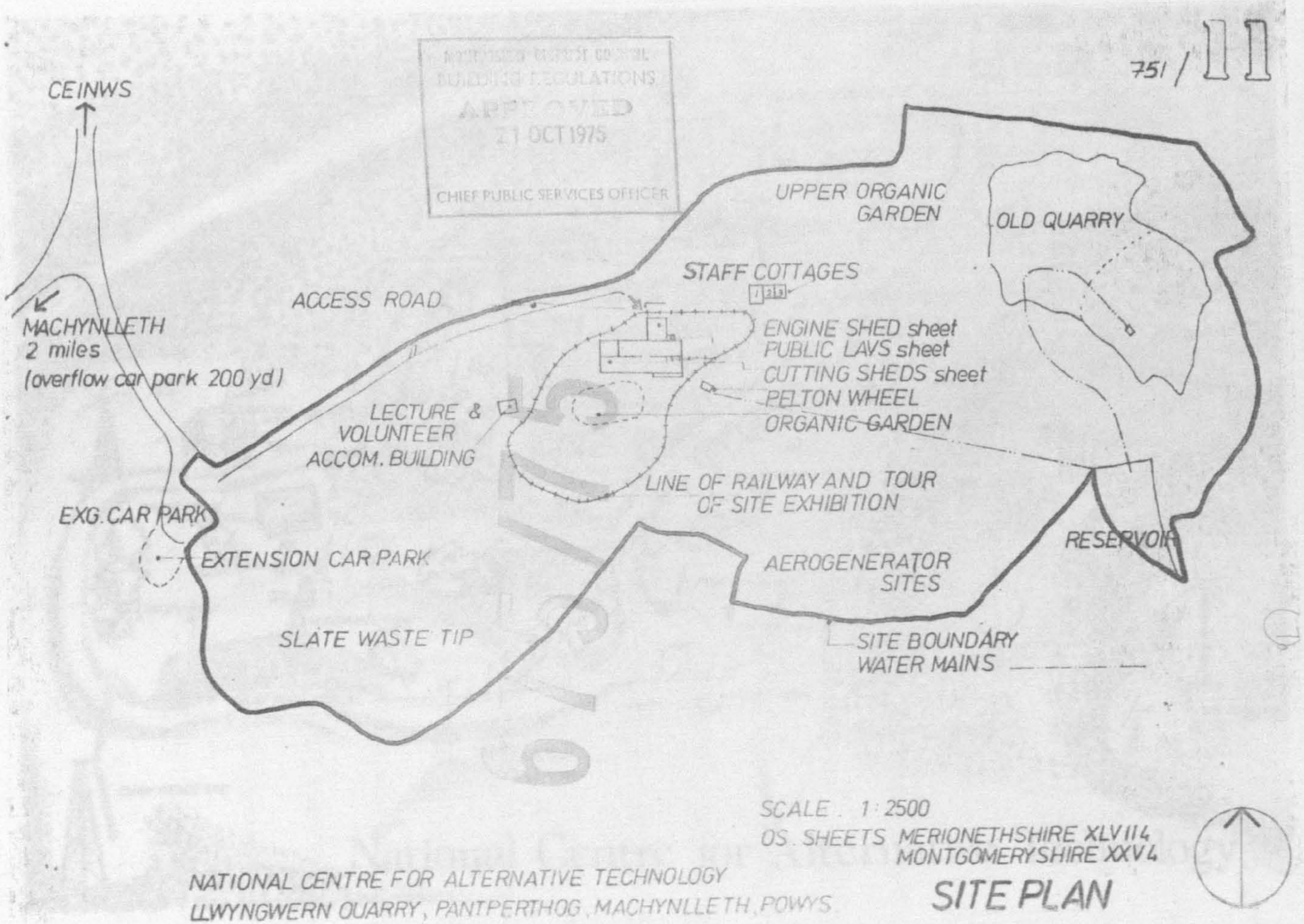

Figure 7.1.2 Plan of CAT site showing proposed installations and layout
Source: CAT Archive

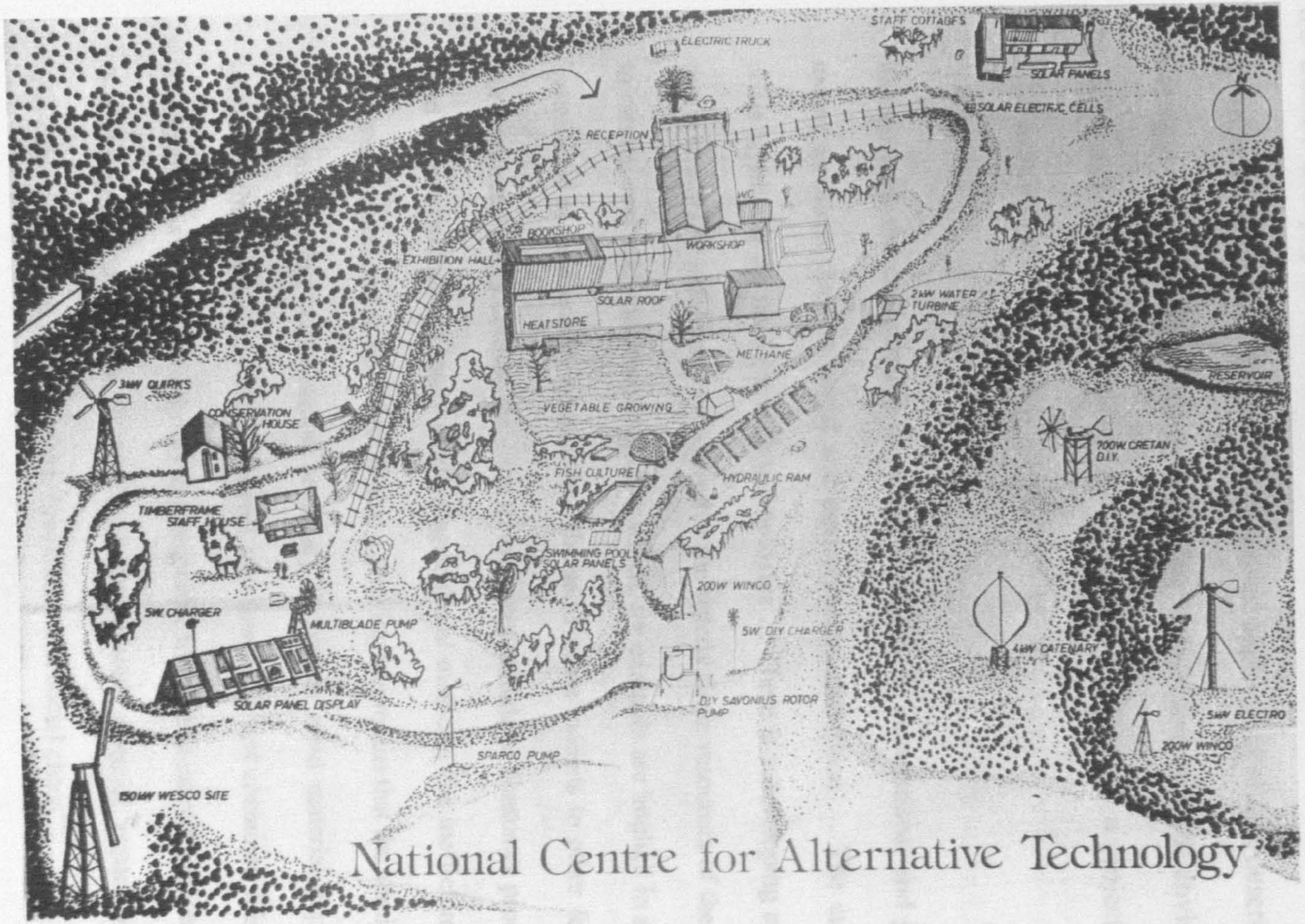

Figure 7.1.3 Graphic illustration of the plan of the CAT site which was included in the Centre visitor guide
Source: CAT Archive

These exhibits, for Morgan-Grenville, both reflected and aimed to address the multifarious ways in which post-war modern society was seen to be degrading both the human and physical environment. In a memorandum dated November 1973 Morgan-Grenville outlines the project's intended application of AT, described as "the employment of techniques which have minimal consequences to the environment"[20]. The document continues to outline the founder's rationale for a project concerned with the demonstration of these types of exhibits:

> Increasingly, the consumption of energy produced by conventional and projected means threatens massive social and environmental disruption ... The current oil crisis highlights the need for such technologies ... There is a developing awareness that it is morally indefensible to consume the strictly finite resources of the earth, or to run the very real environmental risks which, for example are implicit in all known systems of nuclear energy generation. The same ethos extends to other features of our resource-hungry civilisation – the throw away attitude to consumer products, the land impoverishment of many modern agricultural methods, the inefficient systems of transportation and so on. There is also a growing awareness that the administration and manufacturing centralisation necessary to sustain rapid material expansion is dehumanising people ... A.T. is a direct step toward [a self contained lifestyle]. Its employment is being seen not only as a technical solution to current problems, but as a philosophical alternative to man's obsession with material expansion and its inevitable association with economic breakdown and social chaos[21].

[20] Untitled document headed simply with the SEI's address, CAT Archive
[21] *Ibid.*

Here, not only energy production but also consumerism, agricultural production methods, transport systems and modern governance were implicated in the breakdown of the organic bonds between humanity and the natural environment. What alternative energy represented was an entire system through which a new approach to civilisation could be employed. Although it was primarily concerned with energy production Morgan-Grenville's vision of alternative technology could also serve to address the social and political as well as environmental degradation, aspects which were considered inextricable in the way humanity existed in the world. It therefore represented an ecologically neutral way of living; one which could restore the organic bonds destroyed by modern industrial society.

The symbolism of alternative technology can be considered through images submitted to the local planning authority of two wind power generators that the project sought to construct on site, depicted here in figures 7.1.4 and 7.1.5. Considering these images enables the meaning of alternative technology in this context to be explored. Alternative technologies were by nature *simplified* technologies a nature that is reflected in the simplicity of the drawings. As considered in chapter 6, the alternative technology movement sought to institute a reduced level of complexity which it saw as unnecessary, environmentally destructive and ultimately dehumanising. The significance of simplification, of both technology and societal infrastructures, was the facilitation of *self-sufficiency*, a concept which by virtue of its small scale and lack of complexity fostered an environmentally and socially benign way of life. Becoming self-reliant in terms of energy and food production through both small-scale simple technologies and small-scale co-operatives negated a dependence on the large-scale industrial practices. Furthermore a shift in focus away from economic growth as a fundamental goal prohibited the kind of consumerism and profligacy witnessed in the western world, concepts that as enunciated in chapter 6 were implicated in the environmental and social degradation of the world. Returning to the sketches, situated in its rural surroundings, at 30ft, the 'multiblade' pumping mill (figure 7.1.5) appears neither as industrial nor large-scale, which at just over half that height could also have been applied to the DAF 'Catenary' windmill (figure 7.1.4) and thus suggests a level of harmony within their environments, which as a corollary to things on a small-scale, contributed to the wider CAT ideology.

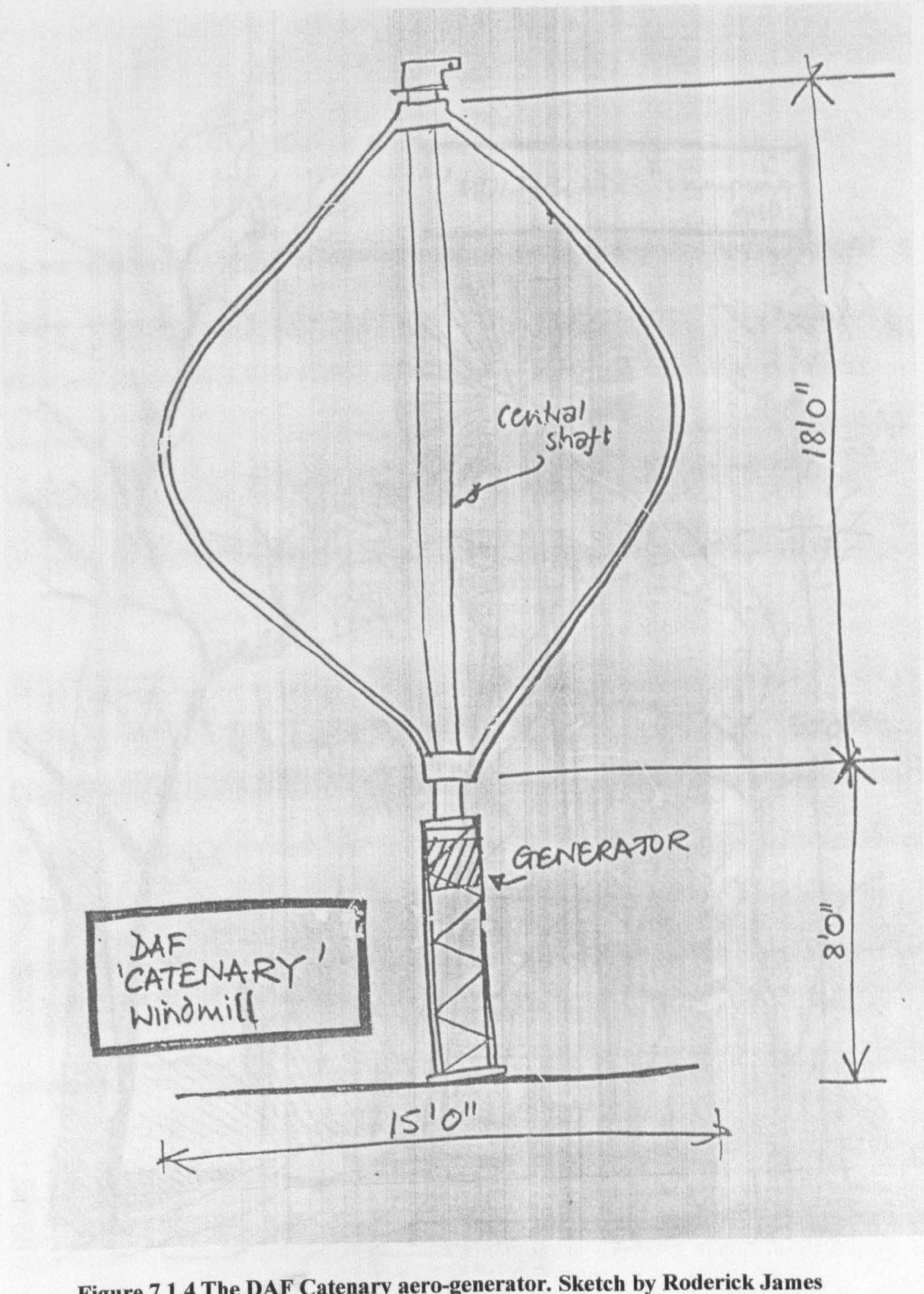

Figure 7.1.4 The DAF Catenary aero-generator. Sketch by Roderick James
Source: CAT Archive

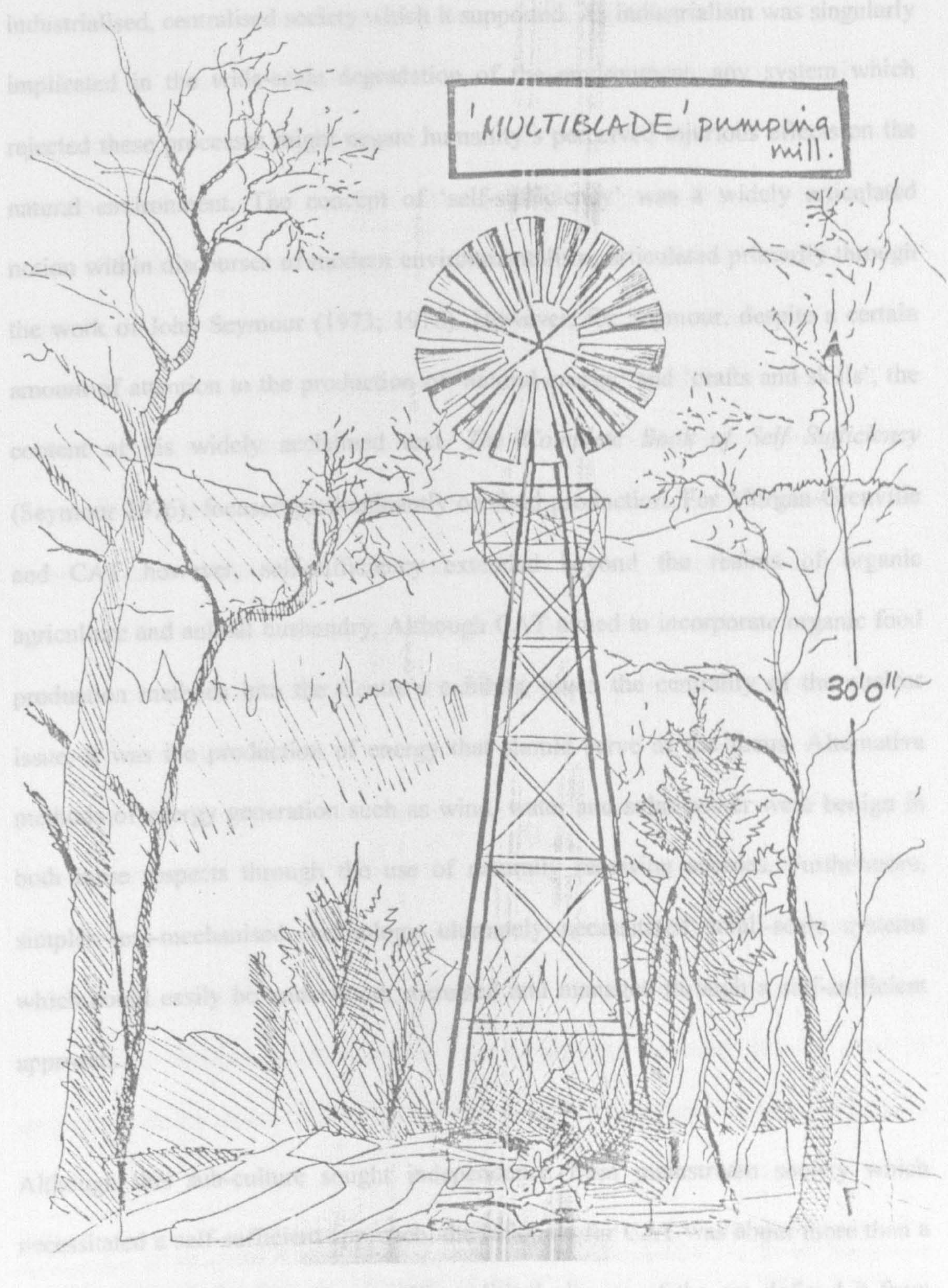

Figure 7.1.5 The 30ft 'multiblade' pumping mill. Sketch by Roderick James
Source: CAT Archive

Being self-sufficient therefore reduced dependence on the State and subsequently the industrialised, centralised society which it supported. As industrialism was singularly implicated in the wide-scale degradation of the environment, any system which rejected these processes might negate humanity's perceived injurious effects on the natural environment. The concept of 'self-sufficiency' was a widely articulated notion within discourses of modern environmentalism, articulated primarily through the work of John Seymour (1973; 1976). However, for Seymour, despite a certain amount of attention to the production of 'natural energy' and 'crafts and skills', the content of his widely acclaimed text, *The Complete Book of Self Sufficiency* (Seymour 1976), focused predominantly on food production. For Morgan-Grenville and CAT however, self-sufficiency extended beyond the realms of organic agriculture and animal husbandry. Although CAT aimed to incorporate organic food production methods into the Centre's exhibits, given the centrality of the nuclear issue, it was the production of energy that should serve as the focus. Alternative methods of energy generation such as wind, water and solar power were benign in both these respects through the use of naturally renewing sources. Furthermore, simpler less-mechanised technology ultimately necessitated small-scale systems which could easily be understood, recreated and managed through a self-sufficient approach.

Although this sub-culture sought independence from mainstream society which necessitated a self-sufficient approach, the rationale for CAT was about more than a conduit to utopian living. The specific political climate of the era defined it from other periods in which groups had previously experimented with social utopias. Unlike earlier experiments with social re-organisation (see Pepper 1991), this was not an idealised, romantic, 'back to the land' version of self-sufficiency: Radical environmentalists were driven by two very real temporally specific threats which stimulated their interest in a project experimenting with self-sufficiency beyond the limits of food production. In the first instance, the oil crisis of the early 1970s highlighted the limits of natural resources and Western society's dependence on this resource[22]. As a response to this, the development of atomic technology for the purposes of the production of nuclear power had become more pertinent amongst the energy Establishment. Coupled with the anti-nuclear movement of the preceding decades this served to compound fears over the threats of nuclear technology to human civilisation. As Peter Harper explains; "The nuclear issue was central to the evolution of the Centre. Almost everyone involved formed part of some anti-nuclear network"[23]. In addition, 'limits to growth' rhetoric had introduced the idea that population growth might outstrip the capacity of the planet to feed itself. Thus, more than just self-sufficiency, AT offered a framework for *survivalism*, many convinced "that the end was at hand and that people needed warning about it"[24]. The two issues combined were pertinent enough as far as the radical environmental movement was concerned to become involved in this type of activity. Not only did AT offer an alternative to environmentally destructive modern energy production systems, it

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[22] The "impending oil crisis" was directly cited in the original planning application as a driver for the development of AT (Powys County Council planning application number 15652) and the archive material relating to the aims and objectives of the project (for example 'National Centre for Alternative Technology, November 1973, Godalming, Surrey: SEI', CAT Archive).
[23] Peter Harper, interview November 2005
[24] *Ibid.*

would also enable the continuation of civilisation in a post-apocalyptic world. It also offered the means to produce food, hand-to-mouth, in the event of shortages rather than dependence on external agencies. For those at the radical polar of the environmental ideological spectrum, lest a sea-change in the societal framework was implemented, it was a case of *when* rather than *if* they would need to draw on their AT know-how. Hence, there was a fundamental belief in the necessity of disconnecting from conventional societal infrastructures due to the perceived inevitable and imminent collapse of society as a result of the exhaustion of both food and oil.

This extremism was something that was reflected in the political philosophy of the Centre. As detailed in chapter 6, the AT movement was borne out of a particular faction of the wider modern environmental movement. However, the specific philosophy of the AT movement and those involved in the CAT project differed to this mainstream environmentalism by way of a radical slant. In this way CAT pioneers did not readily conform to existing political ideologies demonstrating their own more active, radical and significantly *revolutionary* bent which sought real alternatives to the dominant structures of post-war society. The specific political philosophy of the CAT pioneers can be measured against David Pepper's typology of environmental political philosophies laid out in his 1991 study of *Communes and the Green Vision*. According to Pepper (1991) the CAT community demonstrated a 'revolutionary socialist' political philosophy[25]. Self-consciously Left in its political inclination CAT held capitalism as the source of environmental ills, a philosophical position that held that change would only come about through social revolution or environmental crisis (Pepper 1991).

This political inclination is reflected in the written histories of CAT. Tracing the evolution of the project Peter Harper (1995) writes that the idea for the centre was based on "a growing conviction that all was not well with the Onward and Upward march of industrial culture, and that some radical, even revolutionary, alternative was necessary for long term survival" (Harper 1995: 4), the Centre's founder later confirming that the centre had an 'early revolutionary ferment' (Morgan-Grenville, 2001: 176). This sentiment is reflected in an early diary entry which records the notion held by some that the community should be "preparing for the post-revolutionary period"[26], this revolutionary inclination is also reflected in the unwritten histories of CAT by the presence in its archive of the first page of an article entitled *The End of Serfdom* by Henry Marsh regarding the twelfth century emancipation of the Serfs[27].

Extending the idea about revolutionary inclinations, for Harper (1995), what unified the CAT community was an anti-industrial sentiment, a vision aligned to an anti-industrial culture dating back to the sixteenth century "tracing a line through the

[25] CAT was included in Pepper's study as it was founded during a period of "high general environmental awareness, and was therefore likely, among all communes, to show the effects of this consciousness" (Pepper 1991: 3).
[26] 18 October 1974, Project Diary, CAT Archive
[27] The date and source of this article could unfortunately not be traced.

Diggers and the Levellers in the seventeenth, the Luddites and romantic poets of the eighteenth, and social critics like Ruskin and William Morris in the nineteenth" a tradition which "in the middle of the twentieth century ... emerged as an accumulation of overlapping movements critical of industrial culture: the New Left, the 'counterculture', conservation and environmental groups, the 'organic' movement, cooperatives, spiritual and personal growth movements, women's liberation, de-schooling, the peace movement" (Harper 1995: 4). This sentiment not only unified those attracted to the project, but also worked to align CAT politically with other related radicalised counter-cultures through an alignment to the ideals of the political Left. However, if the political philosophy of the Centre is to be measured against Pepper's typology, the ideology of the CAT activists also drew on the philosophies of the political Right. In their subscription to 'limits' rhetoric and the expression of an anti-industrial spirit, these environmentalists according to Pepper (1991) might also register on the 'traditional conservative' spectrum. Despite this sympathy with the ideals of a more Conservative political inclination, in their subscription to a communal way of life, drawing on socialist ideologies, the way the CAT activists went about achieving these ideals was of a wholly Leftist expression. However, regardless of politics, in their expression of environmentalism the CAT activists demonstrated a *radicalism* in their desire to resort to a former societal system and to do so rapidly, a sensibility common to both political-philosophical strands.

In order to achieve self-sufficiency those pursing this goal would have to become educated in the basic engineering of the systems required to achieve this mode of lifestyle. Thus, the use of simpler technologies both necessitated and facilitated the *demystification* of technology, itself an integral component of the wider AT movement and the activities at CAT[28]. Through its simplification, technology and technical processes could become something accessible to all[29]: a "Citizen's Advice Bureau for Technology" as Steve Boulter had positioned the Centre prior to his departure[30]. In practice, this was an iterative ad-hoc process. As one early CAT pioneer recalls, "even on the buildings side, you know there were a lot of jobs getting done and having to be taken apart and re-done" a function of "a lot of enthusiasm and very little knowledge"[31]. This unravelling of technological systems contributed towards the project's 'self-sufficiency' goal through enabling individuals and communities to become technologically 'fluent' thereby moving away from the confines of centralised societal control. As argued by AT theorist Langdon Winner (1979) the complexity of technology worked to reinforce societal frameworks and patterns which controlled modern society. Its demystification[32] through reduction and simplification not only empowered communities to have greater autonomy in their own lives, it also subverted the effects of these imagined societal frameworks.

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[28] Interview with Bob and Liz Todd, November 2005. In a 1979 Centre Newsletter 'Demystification was described as a process which encouraged "experts to share knowledge and thus share power" (Quarry Association Newsletter, Summer 1979, CAT Archive).
[29] *Ibid.*
[30] Boulter, S., 1974, 'AT goes boom', Undercurrents 7, 4
[31] Bob Todd, Interview with Bob and Liz Todd, November 2005
[32] The aim of the AT movement to demystify technology was illustrated by the type of articles carried by the AT press which took pains to describe the systematic (de)construction of basic technologies. For example *Undercurrents* 7 included instructions on how to build Medium Wave and VHF transmitters, an article that was complimented by hand-drawn illustrations. The aim of such articles was the liberation of technologies, in this example communications technology; a mode of societal control that in the minds of radical environmentalists should be reclaimed by the People.

Through the demystification of technology, the Centre worked to achieve the primary goal of its principal funding body the Society for Environmental Improvement, which purported to hold environmental educational as its primary objective. Described in the planning application as a 'Research Establishment'[33], through the demonstration of AT, Morgan-Grenville aimed to disseminate this information and thereby educate others in the application and social integration of AT and transfer this knowledge to others through educational programs based at the centre. He also hoped ultimately to co-ordinate the activities of the centre with those of other educational facilities in Britain, including universities. A national centre would thus serve to amalgamate available international AT knowledge and facilitate the co-ordination of a future research agenda which he saw as lacking[34].

In terms of education and expertise, the mood was one of reflexivity. Although the project hoped to educate people they also welcomed the knowledge of visitors and those who could offer advice. In 1977 Martin Partridge visited the Centre on behalf of *Undercurrents* magazine. According to his report one billboard stated "We do not know all the answers. Many issues have yet to be fully resolved and we welcome your constructive comments"[35]. Despite the sense that simpler technologies should be worked out it was a matter of common sense and logistics that the application of proper technical know-how would be valuable to the project and facilitate this aspect of its success. Furthermore it was the consensus that a technical or practical inclination was a personal quality that should be sought in those joining the project.

[33] Powys County Council planning application number 15652
[34] *Ibid.*
[35] Partridge, M., 1977, 'CAT's cradle', *Undercurrents* 19, 11-13

In an anonymous and undated document entitled 'A definition of our role at Llwyngwern Quarry' and marked 'private' the author(s) states that

> I am not personally convinced that *we* need chemists or engineers to develop AT. But it is true that we do need to be sufficiently chemically and mechanically aware to be masters of the gadgetry ourselves as well as to perceive the possibilities for improving it and, thereby, to be able to stimulate or provoke others into doing it. What I am saying therefore is, in addition to a personal conviction, our members (or the majority of them) need to be practically orientated toward the AT hardware. Put another way it will not, in the long term, be the AT boffins who make an alternative society credible, but the people who adopt its principles and prove its validity. We should try to accept into our community individuals who wish to *be* the state symbolised by AT in preference to those who wish to *do* experimental scientific research as an end in itself [original emphasis][36].

The document is not dated, however (as a demonstration of the approach outlined in the document) the appointment of CAT's first Technical Director, a young post-doctoral Engineer called Bob Todd, suggests it was written sometime prior to his arrival in the autumn of 1974. Todd and his wife Liz had first heard about the project on a late night BBC news programme early in 1974[37]. Todd explains that by the early 1970s he was already demonstrating a predilection to the counter-cultural movement

[36] The style and content of this particular document compared to others archived documentation suggests the authorship of Morgan-Grenville.
[37] Interview with Bob and Liz Todd, November 2005. According to Todd, the program focused on the project's requisition of what has hitherto referred to as 'Tea Chest', a mobile kitchen that had been donated to the project by the Ideal Home Exhibition. The building still functions as the project's communal kitchen where lunch is cooked (on a rotation basis) and eaten communally for a nominal charge. As much of the Centre's produce as possible is used in the provision of meals.

considering "the whole question of resources and long term future environmental scenario" recalling that he had a "technical interest in the renewable energy ... as being a potential solution to some of the environmental questions" and that he had "dabbled in a few technical things and taught [him]self a lot about what was happening with the solar and wind"[38]. Sympathetic to the burgeoning movement, and disillusioned with his engineering research work at Southampton University, Bob and Liz Todd had visited the project shortly afterwards. On returning home to Southampton after a couple of visits to the centre in the March of 1974, in a complete reversal of his earlier rejection of the application of expert knowledge, Bob Todd recalls receiving several telephone calls from Morgan-Grenville attempting to persuade him to offer his services and join the project. Aware of the dearth of proper engineering knowledge, in pursuit of both *progress* and *credibility*, Morgan-Grenville saw the benefit of bringing this type of skill to the project. Bob and Liz Todd subsequently abandoned the relatively comfortable and pleasant climes of the Hampshire coast and headed north to the Welsh hills.

7.1.3 Alternative Technology III: Symbolism over Efficacy

One of the first exhibitions of alternative technology and something which became a visual symbol for the Centre appearing on several initial publications (and which still forms the basic structure of the Centre's logo) was a 'Cretan' windmill (see figure 7.1.6), an exhibit that had been designed and built by Bob Todd. As a result of his academic background Todd had brought with him a number of useful links to the

[38] Bob Todd, Interview with Bob and Liz Todd, November 2005

wider academic community working in the field of alternative technology engineering[39]. It was one of these contacts working at the University of Liverpool who assisted in the design and construction of this particular piece of equipment. Although the ideals of the Centre were to demonstrate a simpler way of living, this did not necessitate a complete rejection of modern science and technology. Indeed despite Morgan-Grenville's earlier rejection of expert knowledge the most advanced engineering expertise was integral to the project[40]. In retrospect, for Todd, for some forms of energy technology, the Centre served as a showcase for technologies such as photovoltaic panels which at the time were in their technological infancy and which the majority of the population had never witnessed[41]. As Todd recalls,

> Most people had never seen photovoltaic panels really. So where most electricity on the site came from was a combination of those things. We had one or two small wind turbines. You know like little ones that tend to get used in the outback in the States and Australia. And we had quite a lot of solar water heating panels at the time round the place, because that was mostly the only source of hot water. And then some wood burning stoves for space-heating[42].

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[39] Two of the individuals that Bob Todd names were Brian Griffiths working at Cardiff University and Griffin McVey working at Brighton Polytechnic. Todd also worked closely with the Solar Energy Society through which conference papers were published on solar heating systems and inter-seasonal heat-stores in 1978. See Todd, R.W., 1978, 'A Solar Heating System with Interseasonal Storage', Conference at the Royal Institution May 1978, *International Solar Energy Society UK Section*, 1-10

[40] There was an anxiety to capitalise on the available knowledge under the CAT name, rather than let it be lost to other organisations. Several practitioners are referred to specifically here: Paul Sillenes, Bob Todd and John Nolan: "we will lose them if we do not give them our full support and encouragement now" ('Outline plan for development at Llwyngwern Quarry', 1975, CAT Archive).

[41] Bob Todd, interview with Bob and Liz Todd, November 2005

[42] Bob Todd, interview with Bob Todd, November 2005

Although the exhibits may have been simple they drew on state-of-the-art technology. Despite this, those closely linked to the project reflect on some of these developments as comparatively amateurish, the initial engagements with technology through which the Centre sought to spread its message demonstrating incredible primitiveness[43]. Describing the first exhibits as "pretty pathetic"[44] Morgan-Grenville found it "difficult in retrospect to understand how ... this embryonic display would be other than ridiculed" (Morgan-Grenville 2001: 170), also stating that he did not "find it surprising that the Nuclear Establishment did not immediately feel its existence terminally threatened, for our 'Alternative Technology', in so far as the generation of electricity is concerned, consisted of two ultra-primitive devices" (Morgan-Grenville 2001: 170)[45]. Morgan-Grenville states that the Centre faced ridicule for proposing measures which although now widely accepted, were contrary to both Government policy and powerful corporate interests at the time (CAT 2000: 2). Although with hindsight Morgan-Grenville regarded both devices as "outstandingly pathetic" (*ibid.*), they were sufficiently accessible perhaps through their simplicity to appeal to public understanding and ignite a spark of enthusiasm for the potential of wind energy.

[43] Morgan-Grenville (2001); Interview with Bob and Liz Todd, November 2005; Interview with Gerard Morgan-Grenville, April 2007

[44] Interview with Gerard Morgan-Grenville, April 2007

[45] Here Morgan-Grenville refers to the Cretan Windmill and a second wind generator that was erected shortly after.

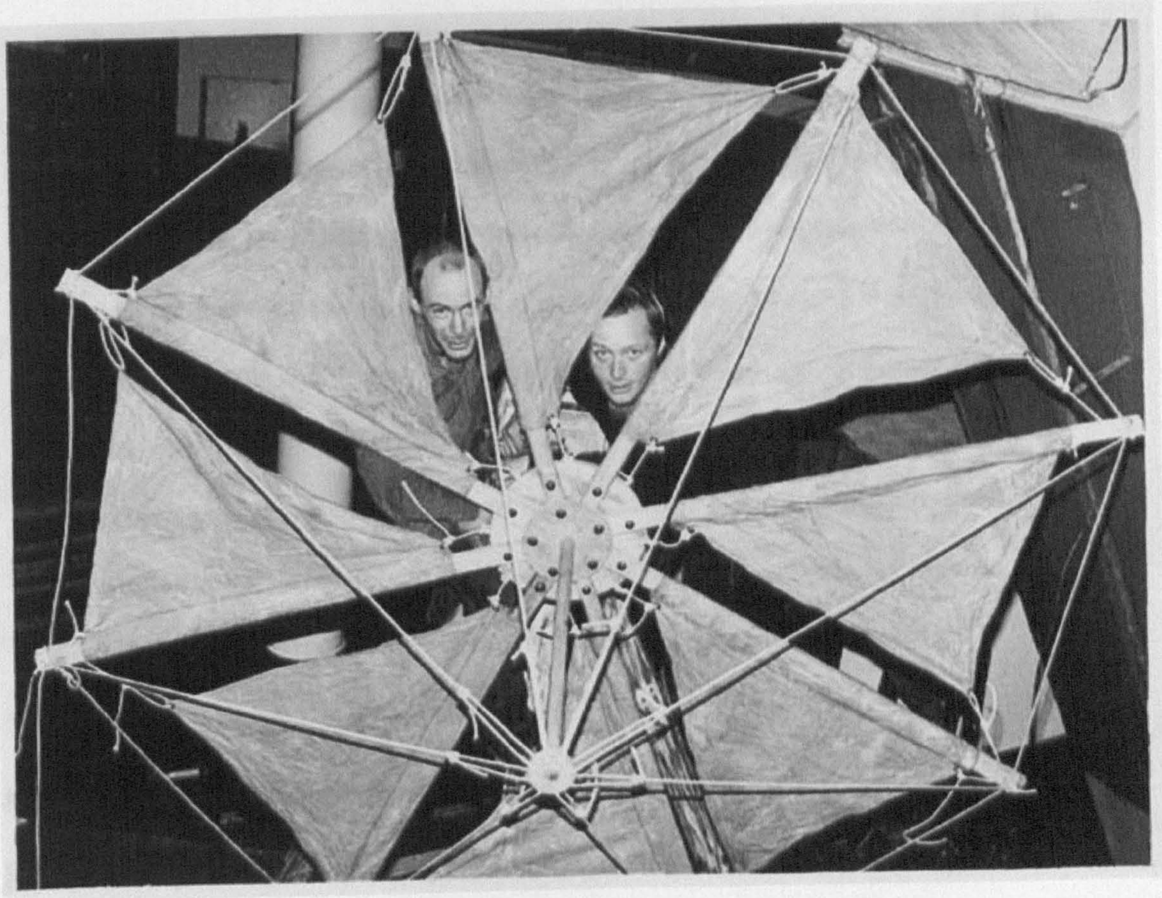

Figure 7.1.6 Bob Todd (left) with the 'Cretan' windmill installed at CAT in 1974
source: **www.cat.org.uk**[46]

However, despite these reflections Morgan-Grenville understood that in spite of their meagre contribution to electricity production their true value lay in the wider message they communicated[47]. As the founder explains,

> Of course [the Cretan windmill] was completely pathetic in terms of electricity production but it was symbolic. And the thing about these early demonstrations at CAT is that they were, they were symbolic and funnily enough, because they were

[46] Accessed (16/05/05).

[47] It is important to note that these reflections on the sophistication of the early exhibits from both Morgan-Grenville and Bob Todd are entirely retrospective. It is perhaps only now that both men consider them comparatively primitive in light of developing alternative energy technologies (which have once again become complex and mystified. See chapter 8).

> symbolic they were very understandable to people, to grass roots, you could go in and see a windmill turning round and lighting a torch bulb. Anyone could see that wasn't the answer to the energy problem but equally anyone could see that geared up it might contribute something and anyone could see that it wasn't dangerous or going to be taken over by terrorists or that it was decentralised and that it was manageable by ordinary people and they could actually make one and it typified the opposite end, it was the polar opposite to nuclear as being unapproachable, dangerous, inappropriate ... It was very much part of the vision. I mean it's all disappeared now but we had a train system, very early days, but trains were symbolic because they were a much more efficient way of moving stuff with minimal use of energy[48].

Morgan-Grenville's frustrations over the primitiveness of the early exhibits were juxtaposed by a belief in their symbolism, which to him and the CAT pioneers was not to be subjugated to concerns over efficacy, a belief also held by Todd who explains that "a very strong part of the argument was to show that you could do it, even if it was only on a small scale"[49]. CAT thus continued in its development of such simple technologies. By the late 1970s the *Appropriate Technology Directory* (Jéquier 1979) described the demonstration as "a dozen varieties of high and low speed windmills for electricity generation and pumping, a small-scale blacksmith forge, a water turbine for electricity generation, a small-holding, a fish-culture, an organic vegetable garden, a cottage relying on wind energy and a large solar-heated exhibition hall" (Jéquier 1979: 242). Given the inclusion of the Centre in the Directory, despite Morgan-Grenville's concerns over amateurism, the exhibition had

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[48] Gerard Morgan-Grenville, interview April 2007
[49] Bob Todd, interview November 2005

found legitimation within the field in which it partially sought to establish itself, albeit not perhaps in more conventional arenas.

Morgan-Grenville's frustration at what he described as the 'primitiveness' of the exhibits demonstrates a deeper preoccupation with a need for socio-political legitimation[50]. It is perhaps for reasons of credibility that Morgan-Grenville so fervently sought the membership of Bob Todd. However, it is perhaps the case that conventional science would only have considered the exhibits as credible if they'd resembled the degree of technical complexity of their conventional counterparts, which corresponding to the AT ideology they were the complete antithesis. It was exactly this primitiveness that the project aimed to promote through its representation of and connection to a simpler way of life. Although for Morgan-Grenville, this was ultimately frustrating as it hindered his perception of the credibility of the Centre, the early exhibits at CAT were symbolic of what could be achieved and communicated a message, a critique of the mechanisms of conventional society, and in this way succeeded in their aim.

7.2 CAT Communities

In addition to engaging with alternative technologies, the project also sought to institute an alternative model of community. Through the establishment the CAT community, the project instituted not only its own local social system but also

[50] Gerard-Morgan-Grenville, interview April 2007

established wider social and community networks. The following sections therefore consider the increasing scales of community to which CAT connected. At its most basic level it explores the socialist egalitarian structures and principles that were implemented within its internal co-operative. At the local scale, how the project and its collective personalities resonated with the local indigenous Welsh community is considered, followed by an examination of how the Centre worked to establish national networks of counter-cultural environmentalism within both alternative and conventional cultural realms.

7.2.1 Internal Networks: Community or Commune?

In addition to the communication of the CAT's 'Green critique' through alternative technologies, the project also sought to convey its message against an increasingly industrialising and thus alienating society through a demonstration of alternative visions of community. Reflecting the ideals of the wider modern-environmental movement, for Morgan-Grenville, modern industrial society had become a threat not only to the environmental but also the *social* integrity of the world through the facilitation of the growth of settlements and centralised societal control systems, specifically administrative and manufacturing networks, which required re-organisation and reclamation through greater autonomy, democracy and co-operation, principles that for Morgan-Grenville were precluded by the structures of post-war industrial society. As Morgan-Grenville saw it the development of a national centre for alternative technology was a practical response to a growing pressure towards individual choice and autonomous lifestyles, the potential for which diminished as a dependence on and conformity with centralised systems grew[51].

As well as restoring these values through a demonstration of a small-scale community the project aimed to demonstrate a model of society which was autonomous at both the individual and the community level, which in turn contributed to a greater degree of self-sufficiency through a reduced dependence on centralised systems. The purpose of this as proposed in the initial planning application was "to permit those who wish to adapt their life-styles to such a form the opportunity to do so", but also, again through exemplifying this "to provide a demonstration of the relevance of such life-styles to any long-term reduction of the environmental problem"[52].

Increasingly industrialised production systems and the centralisation this necessitated also fostered an increase in settlement size which the modern-environmentalists argued led to the fragmentation of communities. This was a process that resulted in the loss of a sense of 'community' and thus the organic bonds which radical environmentalists saw as characteristic of medieval communities (Pepper 1984). As previously identified in chapter 6, the CAT pioneers were not the first to experiment with alternative visions of community, thus building on a historical tradition set most notably by visionary's such as Robert Owen who experimented practically with these

[51] Explanatory note A, Powys County Council planning application number 15652
[52] *Ibid.*

ideas[53], but also his contemporaries William Morris and John Ruskin of the Guild Socialists and the Arts and Crafts Movement who in the late-nineteenth century renounced the autocracy of large-scale production systems and industrialised society, calling instead for an emphasis on human-scale production and craftsmanship (Harrod 1999). CAT was a close approximation to Owen's New Lanark community which experimented with such environmental principles as self-sufficiency, an organic agricultural base combined with small industry, public kitchens and communal eating and child-care (Pepper 1991). Echoing Owen's method (although not explicitly following it) Morgan-Grenville sought to institute this new model of society through engagement with alternative technologies as well as small-scale communities which by virtue of their size and thus self-reliance could achieve a greater degree of autonomy.

Essential to achieving this idea of community was a shared ideology and vision for the Centre. The 'membership' of the community through those the project sought to attract was therefore something that was self-consciously and actively pursued by Morgan-Grenville. This was retrospectively confirmed by Bob Todd who recalled that "Morgan-Grenville wanted it to be more of a place where people came together because they had the same ideology rather than getting all this technical expertise in for the sake of technical expertise"[54]. This is confirmed in the document entitled 'A

[53] See for example Harrison J. F. C., 1969, *Robert Owen and the Owenites in Britain and America: the quest for the new moral world*, London: Routledge and Kegan Paul; Morton, A. L., 1969, *The life and ideas of Robert Owen*, London: Lawrence and Wishart
[54] Bob Todd, interview with Bob and Liz Todd, November 2005

definition of our role at Llwyngwern Quarry' which, after pointing out the need for people who are AT-minded, states that

> This question of 'preference' of one person over another is one which we cannot dodge with honesty. It is a mathematical certainty that if more people apply to join us than we have room for their acceptance must be a selective process. It seems that if we apply standard social criteria, such as education, age, health, wealth etc., or even the more subjective social criteria such as likeability, image and so on, we will, however hard we try to avoid it, start to build up an elite. Perhaps we should establish one principle criterion – personal conviction about our corporate philosophy. To a large extent if this single criterion is met most other criteria will then either prove irrelevant or will fall into place[55].

Despite a recognised need for technical expertise, the final comments reveal that Morgan-Grenville was judicious in this aspect, placing personal ideology above the technical integrity of the project. The CAT community was therefore a purposefully engineered community based on a shared ideological vision. Although no official records exist to document either the numbers or purpose of those permanently or otherwise resident at the quarry during this period, from a reading of the initial diary entries, during the initial construction phase, a small but critical group of committed individuals both paid and unpaid lived and worked on site. There is a sense that not all of these 'personnel' were gainfully employed and at least some worked voluntarily out of a commitment to the wider purpose and ideological underpinnings

[55] *A definition of our role at Llwyngwern Quarry*, CAT Archive. The document is neither dated nor authored, however, its style and content suggests the authorship of Gerard Morgan-Grenville.

of the project[56]. Various late night conversations and discussions over dinner are documented throughout the 1974 diary, which reveal a deep interest and concern from those present regarding the future of society and the natural environment thus illustrating this sense of a shared ideology.

Corresponding to the socialist principles of the predominant political philosophy, egalitarian principles were actively deployed. Limited resources were shared, out of both an advocacy for a reduction in material possessions but also a fundamental necessity given the limited financial resources available to the Centre. As Morgan-Grenville explains

> the reason it was a community is that it was the only way you could live unfunded and get something done ... because there was no money we had beat up old caravans that had been abandoned on site to live in, we had sort of a central cooking arrangement and feeding arrangement ... not everyone had the tools of the trade, we had to share everything we had, we probably had one car for everybody. So it became a community, it couldn't have been anything else[57].

These communal arrangements extended to both domestic and working duties which were equally divided. Tasks such as cooking, cleaning and reception duties were shared on a rotation basis which created according to the twenty-fifth anniversary publication a lack of distinction between 'work' and 'life' during the embryonic stages of the project (CAT, 2000: 5). One of the main daily foci was the preparation

[56] Project diary 1974 and 1975; miscellaneous correspondence; SEI financial records, CAT Archive
[57] Interview with Gerard Morgan-Grenville, April 2007.

of a communal meal which was shared at Tea Chest, a mobile unit donated to the project by the Good Homes exhibition of 1974[58] and depicted here in figure 7.2.1 much as appears today, a practice that has endured the evolution of the Centre over the past three decades.

Figure 7.2.1 The CAT Community sharing a communal meal in Tea Chest, c. late 1970s
Source: www.org.cat.uk[59]

By the stage the visitors' centre had opened in July 1975 there were more than twenty people including ten children living on site. People who worked together also shared the (meagre) provisions and living arrangements, which extended to the amount of

[58] Interview with Gerard Morgan-Grenville, April 2007
[59] Accessed 16/05/05

electricity available for even the most fundamental of domestic chores[60]. These aspects reflect the nature of the project at the outset, not just as an occupational venture, but as a holistic working and living environment, where both domestic and work-related duties were shared.

This sense of egalitarianism also extended to remuneration. There are no records to confirm to whom these monies were paid and for what services, however records confirm that contrary to his expressed antipathy towards the use of 'experts' Morgan-Grenville was not averse to paying for this type of service in order to carry out particular tasks. For example, in addition to the commission of Steve Boulter to locate a feasible site[61], from the outset a project manager was employed to manage the on-site development of the project in the founder's absence as well those that brought some element of 'expertise' such as a permanent engineer and organic horticulturalist. This division between those who were paid and those who were not, obviously had implications for a project attempting to institute an egalitarian society, however, in an attempt to mitigate conflict, rather than according to a conventional system of meritocracy, wages were allocated according to the number of dependents, a practical expression of the socialist slogan 'to each according to their needs' (CAT 2000: 5). However, for some the 'pay' constituted little more than "accommodation and a bit of pocket money" or a system "run on volunteer labour providing food and

[60] Liz Todd recalls how "there'd be a sort of call in the evening that there was enough power to run the washing machine" (interview November 2005).

[61] Later correspondence between Boulter and his employer reveals a disagreement between the two over Boulter's activities: Morgan-Grenville objected to Boulter's supplemental employment as a Lecturer at University College London. This resulted in Morgan-Grenville subsequently refusing to settle part of Boulter's bill and he returned to the US partially unpaid for his work relating to the project. Earlier claims that Boulter left the project as a result of ideological differences can perhaps (given the reliability of this source material) be read as a smokescreen to protect his personal integrity.

a sort of roof over your head"[62]. Needless to say the wages those that were paid received were meagre[63].

In reflecting on the exact nature of the CAT community, its consideration by Pepper (1991) is perhaps testament to this. The Centre's emphasis on community warranted its inclusion in Pepper's (1991) study of British Communes in which he aligned communal living to a distinctly 'Green' vision. Through its experimentation with small-scale community living CAT reflected the characteristics of a 'commune'; a shared living and working arrangement for a given community, which included the demonstration of a shared purpose and common goals, reflecting one another's ideologies and cultural identities (Pepper 1991). Pepper (1991) argues that communes have historically been the pursuit of marginalised, alternative cultures, but primarily religious groups[64]. During the twentieth century, this trend continued as environmentalists through the pursuit of both a physical and ideological severance from mainstream society also implemented this way of living as a model towards a social utopia (Pepper 1991). As Peter Harper explains the pursuit of alternative technologies "chimed beautifully with the whole interest in communities, communes, new age living, not nuclear families but nice little essential communities. It all fed into that and it all seemed to fit together nicely, that you could have a kind of utopian society"[65].

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[62] Bob Todd, Interview with Bob and Liz Todd, November 2005
[63]; Interview with Roderick James, April 2007.
[64] Pepper (1991) provides a historical review of communes dating back to the eighteenth century, finding that although they were not specifically a response to a widely perceived environmental crisis, they nevertheless demonstrated elements of 'green' practices and principles.
[65] Peter Harper, interview November 2005

Despite Pepper's classification of CAT as a commune, those who resided there in its embryonic years contend that rather than a commune, CAT operated as a functioning *community*[66]. This categorisation is also reached by Morgan-Grenville who on reflection over the deliberate social engineering of the community states that "it was an ingredient, we clearly needed people and what became apparent early on was that some people really were happy to be involved on a nine-to-five basis but they lived somewhere else but the majority at that time were talking about communities, not communes, communities" making the distinction that "a commune is everything in common ... and a community is simply a group of people trying to do the same thing in the same place and it was the latter that it became and to an extent still is"[67]. This characterisation is confirmed by Bob and Liz Todd who contend that it did not specifically operate as a commune, although elements of small-scale community organisation were adopted[68].

Although some egalitarian practices seemed to work, the application of this principle to decision-making was ultimately more problematic. A lack of leadership instead of providing an idealised method of decision-making often led to conflicts within the CAT community. Although the broader aim of the project was more-or-less agreed between Morgan-Grenville and those on site, the nature of these debates were primarily focused around the exact way it was to be achieved, discussions that were

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[66] Interview with Bob and Liz Todd, November 2005

[67] Interview with Gerard Morgan-Grenville, April 2007. Significantly, commentary on the community component of the project is largely absent from the founder's autobiography, emphasis instead placed on the environmental and technical agendas of the project, itself testament to the importance of this component of the project. It was perhaps the case that the fact that this element failed, warranted its exclusion from the text which places emphasis on Morgan-Grenville successes over his failures.

[68] The type of visitors the project attracted in its developmental stages is further testament to way the project was perceived by external groups as an experimental small-scale community. See 8.2.3.

recorded in the Project Diaries. For example on 2nd March 1974, Tony Williams, then employed as project manager noted:

> Steve is still serious about his railway project and it is fast becoming a local joke. He has organised the clearing of vegetation without consulting anyone. An obvious divergence of views is occurring, so much so that I suggested we adjourn to John [Beaumont]'s in the evening to discuss our differences and to put our cards on the table. This we did and our long term views seem to roughly coincide, tho' [*sic*] Steve [Boulter] leans towards an academic set up[69].

Despite attempts to resolve these conflicts, the egalitarianism manifest at the centre meant that decision-making often amounted to a battle of wills, Williams later commenting that "[Steve is] determined to go ahead with his Disneyland concept and I am determined that he won't"[70].

Such conflicts stemmed from the unique variations on the broader ideology that the centre sought to communicate. Although most agreed on the common goal, the way it was to be achieved was often the subject of fierce debate. Bob Todd's 'plastic gutters debate' serves to illustrate such conflict:

> you can go down to the builder's merchant and buy some plastic guttering very cheap and you know its going to last for sixty years or more and it'll do a very good job. And there's the pragmatists saying "look we've all these buildings to build;

[69] 1974 Project Diary
[70] *Ibid*, 9th March 1974

we're building a visitors centre, let's just go and buy the plastic gutters". And you've got other people there saying "no, no, you don't want plastics: the whole point is we're trying to use natural resources, renewable resources, we don't want to use things that have environmental compromises involved in their manufacture and slave labour and everything else". So there were other people arguing for carving the gutters out of trees that fell down the hill and those are the two kind of extremes and that kind of debate went on all the time as to what extent you say "we're trying to achieve this objective and if we have to make a lot of compromises along the road then never mind"[71].

This was evidently an example of *pragmatism* versus *purism*. Todd states that the debates were very much dependent on the individual personalities at the Centre, which supports the notion that decisions were made on a co-operative, democratic, egalitarian basis rather than a top-down process[72].

For many, this new model of egalitarianism and communal living not only obstructed progress at the centre but threatened personal relationships, a factor that was again documented in the written archive of the project. In voicing these personal conflicts for example, Tony Williams reports that

Steve, Pat and Cliff all left this morning, leaving me on my own, which in a way, is a great relief ... John's – senior and junior visited, most pleasant to be able to entertain in my own home however rude it may be. I was in the middle of cooking a nice non-

[71] Bob Todd, interview with Bob Todd, November 2005
[72] *Ibid.*

vegetarian dinner when Nigel arrived, quite unexpectedly, so my hopes for a quiet meditative week have been dashed. Learning to live with people is harder than learning to live without them (1974 Page-a-day diary, 11 March)

Evidently the close quarters in which the activists were forced to live, for some worked to compromise the experience of working towards a common goal. The existence of a shared ideology and recognition of a common purpose was perhaps insufficient to sustain the human bonds necessary for communal living, particularly in the context of the already testing domestic conditions. As with the communities Morgan-Grenville had visited in the San Franciscan hills these conflicts illustrate the fragility of communities experimenting with co-operative structures, according to Pepper (1991) a common condition of autonomous communities. Less than two months after this entry Williams resigned from his position as Project Manager. Williams' departure as well as that of Steve Boulter and several others in the summer of 1974 was reported in the alternative press to have come about as a result of disputes over the best way for the centre to fulfil its objective of the advancement of AT[73]. Although there is no evidence to suggest that these reasons are invalid, the social framework through which the project sought to achieve these objectives may also have been significant.

[73] Ed., 'Stop press: the Centre cannot hold?', *Undercurrents* 7, 4

These conflicts however were perhaps most notably present between Morgan-Grenville who was living off-site and the on-site community[74]. As Bob Todd recalls:

> We had a lot of discussions about to what extent the place was self-determining. Was it actually the people who worked there who were going to make the big decisions about its future or was it still Gerard's chargeable trust that he set up? And so there was some heated debate about exactly what the roles were ... was it really a self-determining co-op or was it not?[75]

To illustrate these conflicts, after attending a meeting at SEI to discuss planning issues for the centre, Tony Williams was disturbed by the proposed size of the project causing him to express concern over conflict between "those who think big and those who are more down to earth"[76]. However, it seems this was just the beginning of a more serious division which threatened to jeopardise the long-term success of the project. The essence of this rift was played out in a series of memoranda exchanged between the on-site community and Morgan-Grenville. In the summer of 1974, Morgan-Grenville writes,

> It is obviously imperative that we should try and identify our collective beliefs so that we can relate these fully to the work we are actually doing and the aims which we

[74] The diary records that Morgan-Grenville remained living off-site, spending as he recalls in his autobiography every other week in residence at the quarry (Morgan-Grenville, 2001). However entries in the project diary, and other archived documents suggests this was less frequent[74]. In a later interview, Morgan-Grenville confirms that "to start with it was never full time because I was also trying to run a company and doing various other things" (Interview with Gerard Morgan-Grenville, April 2007).
[75] Bob Todd, interview with Bob and Liz Todd, November 2005
[76] 21 February, 1974 project diary, CAT Archive

publish. Without understanding our purpose we risk both confusing ourselves and those whose lives we influence. I want to try and sharpen the focus which is, I suspect, presently a little blurred[77].

Given Morgan-Grenville's experience and background in enterprise, he was likely privy to the knowledge (that perhaps others were not) that for a enterprise to succeed, particularly one that claims to be acting in a co-operative way, a unity of purpose between its members is essential.

Despite these efforts to co-ordinate their ideas about the objectives of the project, the ideological rift between the founder and his staff continued to widen. This is illustrated by a series of three memoranda between Morgan-Grenville and the working party at the quarry in the following December. Although agreement over the wider purpose of the Centre had been reached, the permanent staff felt it necessary to outline specifically their proposal for the site which appeared to differ from that of its founder. There is also a sense that they sought a greater degree of ownership and autonomy over the project. The seven aims of the project as the permanent staff considered them were singularly concerned with the demonstration of AT hardware, an objective which diverged from Morgan-Grenville's vision which although centred on this objective purported to communicate a more holistic message of technology, environment and society. As Morgan-Grenville explained,

[77] 'Constitution for the citizens of Llwyngwern quarry', CAT Archive

> The project which is now defined differs basically from that which I have tried to conceptualise. It is now a straightforward scientifically based operation – as opposed to an experiment in living in which the cream of AT hardware would provide the means toward a comfortable 'low impact' and largely self-sufficient existence. As previously defined, specialist skills would support non-specialists living at or near Llwyngwern and trying to exemplify 'a new life-style' which would relate to ordinary people. The role of the specialist and non-specialist are now reversed[78].

Unprepared to compromise, Morgan-Grenville stated his intentions to withdraw from his position on the project leaving him "to develop the interests of SEI from wherever [he] may be" and sever it altogether from SEI rendering it fully autonomous, an objective he always intended to pursue. In a document entitled 'Outline plan for development at Llwyngwern Quarry' dated 1975, Morgan-Grenville wrote: "I conceive the centre as being an autonomous unit, brought into being by SEI, but ultimately becoming self-funding, self-determining, within the terms of its charter". However a proposal was made to maintain some financial support through SEI. Despite these strong words Morgan-Grenville continued to work with the project albeit with increasing distance. For Morgan-Grenville, relinquishing control over the project at an early stage in its operation corresponded entirely with others' and his own perception of himself. Morgan-Grenville is both remembered by his CAT peers and positions himself as a catalyst for the creation of projects rather than someone who will oversee its development[79]. As Bob Todd recalls, Morgan-Grenville "was

[78] Memorandum from Morgan-Grenville, 30th December 1974
[79] Interview with Bob and Liz Todd, November 2005; Interview with Peter Harper, November 2005; Morgan-Grenville (2001).

very much a starter of things; an inspirer and an asker of awkward questions ... he came and worked for the odd week, but it wasn't really a full time thing. I mean he wanted it to get its own momentum and go"[80]. In his words "I am very much of the opinion that the founders, unless they're fully engaged in the thing shouldn't really hang around criticising ... the given wisdom is that if you start something you should run it and I don't agree with that way at all. I mean some people have the ideas and others have the ability to produce continuity .... I was the hands on ideas man"[81]. The way Morgan-Grenville distanced himself from the project soon after its institution was thus not atypical of the type of individual Morgan-Grenville was.

However, the conflicts between the founder and the project's resident community illustrate a deeper divergence between himself and culture with which he sought to integrate through the pursuit of a more environmentally and socially benign approach to existence. These contrasts were essentially founded on differences in background and upbringing, experiences which, through a particular education system and subsequent military training, were reflected in his approach to the project. In his own words Morgan-Grenville was a *doer* rather than a *thinker*, being of the opinion that "those who seek to implant a new consciousness upon the world cannot afford to dissipate the savage energy they need in taking too much account of the 'ifs' and 'buts'" (Morgan-Grenville 2001: 158). He later reflected "I think I was probably brought up in a family that once they'd identified a problem intended to do

[80] Bob Todd, interview with Bob and Liz Todd, November 2005
[81] Interview with Gerard Morgan-Grenville, April 2007

something rather than sit and say what a problem it was"[82]. Although Morgan-Grenville sought to set himself apart from conventional society and the Establishment he so fervently sought to reject, he clearly couldn't conceal these connections and on certain levels his way of operating was typical rather than atypical of his conventional peers.

Conflicts experienced as a result of trying to establish an egalitarian community perhaps resulted in the subsequent abandonment of this objective. It could be conjectured that although the centre in its formative stages explored ideas of becoming an autonomous community and certainly adopted elements of communal living, as a result of these internal conflicts and also through the evolution of the project this element of the project became less important in favour of more fundamental organisational foci, i.e. the demonstration of AT and the dissemination of its core message[83].

This shift in focus from the ideological to the practical considerations of the Centre is attributed by some to the arrival of a dynamic young architect by the name of Roderick James in the summer of 1974. Trained at Kingston Polytechnic, James was

[82] Interview with Gerard Morgan-Grenville, 17th April 2007

[83] These changes over time are reflected in the nature of the diary entries in the project diaries of 1974 and 1975. Over the course of the two years over which the main physical components and alternative technology exhibits come together a less holistic record of life at the quarry is recorded, exhibiting fewer personal reflections and by the end of 1975, comprising more of an 'appointments diary', limited to 'work' (rather than domestic) related aspects. This observation alone offers an insight into the metamorphosis of the site from a rather disorganised, ad-hoc, construction site where the ideology and purpose of the site is in constant negotiation, to a space - both physical and imagined - where these aspects are distinctly divided, organised and managed. This not only reflects the working and living space into which it rapidly evolved but also the sense that over time the centre has organically.

living and working locally when he heard about the project[84]. According to Bob Todd, James had been "building a house from a ruin and completely changing it into one of the most amazing houses up on one of the hills not far from here at Cemmaes"[85]. For those already involved with the project, James' arrival marked a sea-change in its history. In contrast to his predecessor Mark Matthews[86], James was considered both more tenacious and energetic in his pursuit of specific goals but also more technical in his abilities. As Bob Todd recalls, Matthews "had been good at getting volunteers and generally organising that but I think he was aware he hadn't got a lot of the skills that were needed to push it forward"[87]. Given his background in Architecture, James brought with him design and construction skills that Matthews knew he did not have and that he recognised were necessary to the progress of the project at the time[88].

As well as the necessary practical qualities, James' personal qualities were also a timely and welcome addition to the project. As Todd recalls,

> I think it did need somebody quite strong like that at the time, otherwise the danger when it's not many permanent people and lots of people coming through, you know, is that it's a bit of a headless chicken. And you get one or two strong minded people

[84] Interview with Roderick James, April 2007
[85] Bob Todd, interview November 2005
[86] Tony Williams was initially employed in this role, which was soon after assumed by Mark Matthews and his wife Mary through Tony's departure less than six months into the project (1974 Project Diary, CAT Archive). Mark and Mary Matthews lived at nearby Aberdovey. Their first visit to the site was recorded on 17th March 1974 where they expressed n interest in working with the project (*Ibid.*).
[87] Bob Todd, interview November 2005
[88] *Ibid.*

come in who say 'we ought to be doing' this and suddenly it goes off pursuing a different direction and so on[89].

For Bob Todd, James was a very practical, enthusiastic, dynamic and energetic individual[90]. This impression of James as someone who was able to get things done is supported by others who worked with him who recall that he "also had the attitude... you know he wasn't frightened; he was quite prepared to go for something. I mean even sort of money worries didn't trouble him. You know if he wanted materials he'd somehow get someone to give them. He was very, very good at getting the things he needed"[91]; and by the project founder himself, who describes the man with whom he established an "enduring friendship"[92] as an "in-house dynamo"; someone who "got things organised and made lots of things happen" providing organisation and continuity[93]. There is consensus that by the autumn of 1974, the combination of Bob Todd and Roderick James is what successfully steered the project in the right direction[94]. As Peter Harper acknowledges, Bob's contribution to the project was invaluable: "CAT wouldn't be here without [Bob]. But also just as a kind of steady voice of moderation. That was the magic ingredient!"[95]. The arrival of James, who was able to bring some strategic focus to the project and Todd who took more of a

[89] Bob Todd, interview with Bob Todd, November 2005
[90] *Ibid.*
[91] Liz Todd. *Ibid.*
[92] Interview with Roderick James, April 2007
[93] Interview with Gerard Morgan-Grenville, April 2007
[94] Roderick James, interview April 2007; Gerard Morgan-Grenville, interview April 2007; Bob Todd ,interview November 2005; Liz Todd, interview November 2005; Peter Harper, interview November 2005.
[95] Peter Harper, interview November 2005

'back seat' role[96] focusing his attention on the engineering tasks related to the exhibits on site, had quite evidently shifted the focus away from ideological to practical considerations.

7.2.2 External Networks I: CAT and the Local Community

Although the project may eventually have managed to establish a working community that, despite some personal conflicts was broadly ideologically aligned, extending this sense of social integration beyond the borders of the project to the local community within which CAT was (at least physically) embedded proved a more difficult task. For Morgan-Grenville, given the counter-cultural environmentalist perspective on the importance of cohesion within local communities which was otherwise seen as degraded by the structures of post-war industrialism, the integration of the CAT community with the local indigenous Welsh population was part of the broader aim as laid out in the *Llwyngwern Quarry's Citizen's Charter*, which specifically stated that CAT's members should attempt to integrate with the local community[97]. Having established themselves at the quarry, Morgan-Grenville (2001) states that the first CAT pioneers were initially met with disdain, disregard and suspicion by the local community, a reaction that continued for some time. In considering this reception, two aspects bear relevance. Firstly the vast majority of those that were brought to the area in pursuit of the project were English. In their recollections of local community relations, both Morgan-Grenville and James recall a

[96] Bob Todd, interview November 2005
[97] CAT Archive, CAT

tangible degree of Anglophobia in the region[98], although this was largely linked to second home ownership, a conflict that had allegedly resulted in the arson of several such properties in the area[99]. Poor Anglo-Welsh relations were a more embedded cultural condition which built on a historical sentiment that rested on ideas of welsh sovereignty, itself the legacy of a century of competing claims to water resources which Welsh communities saw as being exploited by their English neighbours to the detriment of Welsh landscape amenity[100]. However, these feelings of hostility were founded on more than just nationality. The CAT community was self-consciously affiliated to the Hippie counter-culture, a social grouping which despite the earlier characterisation of the area as a 'landscape of alternativeness', was relatively unfamiliar and significantly *counter* to the indigenous traditional Welsh identity. By virtue of their rejection of the wider values of conventional society, as explored earlier alternative cultures have been traditionally detached and removed from conventional culture (Pepper 1991). Furthermore, the activities with which they were involved worked to reinforce this external perception as according to Jéquier (1984), there was an assumption that those involved in the development of alternative technologies were certainly affiliated to marginal social groups. Feelings of cultural difference therefore contributed to the initial suspicion displayed by the local Welsh community who were unequivocal in their prejudices towards the CAT affiliates.

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[98] Morgan-Grenville 2001; Gerard Morgan-Grenville, interview April 2007; Roderick James, interview April 2007
[99] Roderick James, interview April 2007
[100] See for example Gruffudd (1990); Roberts (2006).

Despite these initial cultural divisions, as far as the activities of the project were concerned, the local community was seemingly insouciant and the CAT pioneers failed to engage the local community on a more socio-political level. Not only is this reflected in the planning material discussed earlier which through a lack of supporting or opposing representation suggested a sense of local ambivalence to the project, but the activities of the project also failed to attract the attention of the local press, thus conveying a sense of disinterest and detachment from the local community[101]. To consider this, ideas of cultural and economic inertia can again be applied. Readings of the contemporary local press suggest that the region was more inward looking, provincial and localised in outlook, where the concerns of the day centred on issues of locality and family rather than global environmental politics. Given the deeper, philosophical considerations of the environmentalists affiliated to CAT, as far as locality is concerned, the project failed to connect to ideas of local identity, regionalism or Welsh nationhood which occupied contemporary local Welsh discourses. This assertion can be reinforced by the idea that, apart from the cultural exodus to the region in the 1970s, there was a net migration deficit, a situation that worked to hinder the flow of wider cultural and national socio-political debates.

Partly in an effort to address these divisions, in March 1979 the Centre opened the 'Quarry Shop' on the Main Street in Machynlleth from where it sold its excess

[101] On 5th February 1974 the project diary recorded that "two local press-men interrupted the days work in the afternoon" (1974 project diary, CAT archive). However the local press carried no articles concerned with project in the ensuing months. 5 days later however the diary also recorded the visit of a group of local school children to volunteer for the project (*ibid*).

produce and other goods[102]. There were two fundamental objectives: firstly this was a practical measure to improve the financial standing of the Centre which in its first years struggled to maintain funding strictly through ticket sales. Secondly, this was a social exercise in community integration attempting to bridge the gap between the predominantly English alternative community affiliated to the project and the local indigenous welsh population of Machynlleth. Selling excess produce would not only provide a direct financial input but might also serve to engage the local community in its activities and wider socio-political message. James recalls that despite some initial resistance and apprehension on behalf of the local residents, this soon dissipated and the Quarry Shop functioned with few problems[103]. The historical connection of John Beaumont to the town and his seeming endorsement of the Centre may have contributed to a greater sense of acceptance on behalf of the indigenous community, although time and the CAT community's lack of disruption to the locale undoubtedly played its part. However, those that were there in the pioneering days of the Centre affirm the idea that despite a recognition of a clear cultural difference between the local welsh population and the English Hippies at the Quarry, local residents were largely ambivalent to their activities at the centre and indeed to its individual and collective personalities[104].

[102] Quarry Association Newsletter, Summer 1980, CAT Archive; Roderick James, interview April 2007. The outlet was established as a separate enterprise operating as The Quarry Trading Company (Quarry Association Newsletter, November 1980, CAT Archive).
[103] Roderick James, interview April 2007
[104] Roderick James, interview April 2007, Bob Todd, Liz Todd, interview November 2005

7.2.3 External Networks II: Wider CAT Communities

Although the meaning of the project may have failed to resonate with the local community, its cultural and environmental significance connected to wider national and international discourses of environmentalism within both alternative and conventional cultural networks and thus exuded a wider geographical significance beyond the locale. Entries in the project diaries reveal a sense of the increasing interest in the project from a variety of interests, public and private, popular and academic, amateur and professional. Over the course of the initial stages of the project, academics, writers, environmental 'personalities', national media and royalty were recorded, testament to the perceived significance of the burgeoning environmental crisis and how the uninitiated were open to learning about this new way of seeing the world.

Most significantly, CAT connected to a wider ideological network of counter-cultural environmentalism through which it attracted volunteers. This was an informal network that coalesced on the basis of cultural identity. Given the remoteness of the site the dissemination of information about the project was aided by the alternative press through publications such as *Undercurrents* and *Resurgence* which carried articles on the Centre and its progress and to which some of those affiliated to the site contributed[105]. However as witnessed earlier in the case of Bob and Liz Todd, news of the project, and thus the wider message of the modern environmental movement,

[105] For example Steve Boulter (see Boulter, S., 1974, 'AT goes boom', Undercurrents 7, 4) and Peter Harper who edited *Undercurrents*.

was also disseminated through more conventional networks such as the national media[106]. This is testament to the significance of the broader message of the project, and its appeal to the 'alternative' community as means of engaging meaningfully in the philosophical cause with which they were affiliated, which itself reflected the degree of disaffection amongst such groups. This was witnessed with individuals such as Bob Todd and Roderick James, who saw the project as a way of engaging practically with the values of the counter-culture they inhabited. For such disciples the importance of the project was sufficient to persuade people to abandon conventionally 'good' positions in favour of the project, which consciously offered significantly poorer remuneration. Keen to assign an indelible impression of accomplishment, Morgan-Grenville notes that,

> Over the coming years many first-class brains and hands were attracted to the place: a surprising number came for a visit and never left. Almost all abandoned promising careers and good salaries in favour of a way of life and aim in which they believed (Morgan-Grenville 2001: 175)

This was about more than a job of work; it was a way of life; subscribing to a particular radical ideology which rejected mainstream conventional norms and values. As Todd recalls "I never regretted it; it was an exciting thing to do"[107].

In addition to a way of mobilising the movement, actively seeking those keen to become involved with such a project this was also a pragmatic measure to bring the

[106] The Todds heard about the project on a BBC news program.
[107] Interview with Bob and Liz Todd, November 2005

much needed man-power to sustain itself, and significantly that which came free of charge. Over the course of the year, the resident community grew. Although in the very early stages the alternative press and other informal networks served to spread the call, the project later instituted a formal volunteer program which was nationally advertised through leaflet distribution[108]. In addition to the more permanent component of the site community, like the communities of the San Franciscan Hills Morgan-Grenville had communed with, there is a sense of a more peripheral transient volunteer community; those who arrived, stayed for an indeterminate length of time before moving on. In many of the diary entries individual's names appear both intermittently and also in consecutive entries with no explanation of their role at the site. Many of these individuals subsequently disappear, often with little explanation of their departure. This kind of transient existence was a common practice within the alternative culture and seemed to characterise the on site community at CAT[109]. Over time, the site community, both paid workers and volunteers grew steadily, evidenced by the occasional recording in the diary of the number of people for dinner where these numbers were exceptional or unrivalled.

The appeal of the centre also extended to the ideologues affiliated to the modern environmental movement from both the national and international community. Those that were recorded in primary and secondary sources included most notably John

[108] Liz Todd, Interview with Bob and Liz Todd, November 2005. Still in operation today, the volunteer program has hitherto been an integral and fundamental component of the project without which its integrity would have been severely compromised at least in the early days when ticket sales were only sufficient to sustain the most basic wages, amenities and living and working conditions (Roderick James, interview April 2007).

[109] Interview with Bob and Liz Todd, November 2005; Interview with Audrey Beaumont, November 2005

Seymour, the highest cultural authority in self-sufficient living whose visits were twice recorded in the spring months of 1974 and 1975. Seymour held a meeting in the area on his second visit[110]. Other notable visitors included Patrick Rivers, author of *The Restless Generation* (1972), a critique of modern industrial society through the consideration of transport systems; the Chamberlain of Bangor University (Agriculture department) who was specifically interested in methods for the recycling of farm wastes; and Leopold Kohr recorded in the project's diary as 'an advocate of small communities', who visited in February 1974 and gave a lecture on small communities to the fledgling co-operative[111]. Then employed as a Senior Tutor in the Extra-Mural Department at the University College of Wales in Aberystwyth, Kohr was an Austrian economist and political philosopher, or a 'philosophical anarchist' as he chose to describe himself (Stephens 1998). Born in 1909, Kohr advocated the organisation of both corporations and communities - particularly nations - on a small scale through decentralisation and more manageable political units and was thus ideologically aligned with Fritz Schumacher. In fact Schumacher had written parts of *Small is Beautiful* in which he acknowledged a considerable intellectual debt to his host at Kohr's house in Puerto Rico. Having reported on the Spanish Civil War in 1937, Kohr eschewed both Fascism and Communism. He also condemned industrial growth and supported the conservation of the natural environment (*ibid.*). The visit by this individual is evidence that there was an inclination towards a kind of social

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[110] Although it was not recorded, given the difficulties the CAT community was experiencing in integrating with the local this may have been an attempt to engage local residents with the project through the common practice of agricultural production given the significance of the farming economy of the nation, although Seymour by this stage owned a 62-acre farm in Pembrokeshire on which he ran educational courses, so clearly had his own motivations for disseminating the message of self-sufficiency.
[111] Project Diaries 1974 and 1975, CAT Archive

arrangement of this nature, which, combined with the broader ideals of the venture, appealed to Kohr's interest. Like its volunteers, these individuals were drawn to the project through recognition of a shared eco-philosophy.

However, CAT's external communities extended beyond the realms of the counter-cultural modern environmental network. Through its founder, the types of groups and individuals that became affiliated to the centre also inhabited worlds that were antithetical to the message of the project and certainly paradoxical to Morgan-Grenville's personal goal to distance himself from the authoritarian structures of conventional society, namely 'The Establishment'[112]. This connection to more conventional socio-political groups began on CAT's doorstep with the landowner John Beaumont whom, given his class background, Morgan-Grenville recognises as being a classic "Establishment type figure"[113]. However, interest from more conventional networks was largely focused in the nation's capital.

Morgan-Grenville's social position in life allowed him access to particular cultural interests and groups, those that would otherwise undoubtedly have remained inaccessible to those without the kind of socio-political connections that the founder's class connections afforded him. It was undoubtedly these connections that led to a flurry of media interest which preceded the opening of the Centre in July 1975. Between 5th February 1974 and 30th September 1975 visits were received from "two local press men", Selwyn Roberts of BBC Cardiff who "wanted to do some

[112] Morgan-Grenville (2001); Gerard Morgan-Grenville, interview April 2007
[113] Gerard Morgan-Grenville, interview April 2007

filming for a couple of weeks", BBC2 ('News Extra'), Welsh radio ('Good Morning Wales' and 'Nationwide Wales Today'), 'The Wild Wilderness' (television programme), Radio 4 ('You and Yours'), *The Daily Telegraph*, BBC Wales, HTV, *Queens and Harpers Bazaar* magazine, Granada Television, BBC Nationwide, and *The Guardian*, each of which subsequently published and broadcast articles through both regional and national media[114]. In reflecting on this media coverage, for Morgan-Grenville it represented a wider reaction to the burgeoning nuclear power debate, opposition to which meant that "the concept of safe energy from ambient sources exerted a strong appeal" (Morgan-Grenville 2001: 170). However, despite an increasing opposition to nuclear power, the linkage of Morgan-Grenville, a member of the privileged upper classes, to a much maligned counter-culture also exerted its own appeal distinct from the project.

As part of the planning process Morgan-Grenville, undoubtedly aided by his business and personal connections, had attracted the 'consultancy' of various high profile individuals. A list of 'Consultants as of June 1973', reproduced in figure 7.2.2, included academics, writers, broadcasters, business leaders and what Morgan-Grenville describes as 'leading environmentalists' representing a range of cultural and commercial interests. It is unclear as to what consultancy services these individuals provided, if any. However, the very clear 'Establishment' credentials of some of the individuals on this unique list are contrary to the 'alternative' character of the project. Even individuals such as the ornithologist Sir Peter Scott demonstrated a more traditional expression of environmentalism through his activities in wildlife

[114] 1974 and 1975 Project Diaries, CAT Archive

conservation. Like Morgan-Grenville, Scott had enjoyed a privileged upbringing, which had afforded him an education at Cambridge and the freedom to indulge in his joint interests of Art and Natural History. This joint membership to the British upper classes almost certainly worked in Morgan-Grenville's favour in securing Scott's and others' patronage.

It would seem these connections extended to the very top of governing authority, attracting interest from both regional and national parliamentary representatives. In addition to a visit from Owen Pryce of the Welsh Office[115], a "man from the industry department" had visited Bob Todd to discuss a grant application[116]. The Centre had also evidently established links with the Department of Energy (of the Conservative Government) evidenced by later visits from senior Members of Parliament as recorded in the 1979 Newsletter which reported that:

> In recent months we have had a visit from Norman Lamont, the Junior Minister at the Department of Energy with special responsibility for electricity, gas and nuclear power and several scientific advisors. They showed a great deal of interest in the Centre and our ideas. We look forward to a visit from John Moore, the Minister for Alternative Energy, early in 1980[117].

[115] 12th February 1974 (Project Diary, CAT archive). No further details were recorded. The visit was prior to planning permission being granted, but as the visit is also not recorded in the planning decision material its purpose is unknown.
[116] 14th August 1975 (Project Diary, CAT archive). No further details recorded.
[117] Newsletter, 1979, CAT Archive. Although John Moore did not officially hold this title in 1979 he was a junior Energy Minister responsible for Research and Development on the UK Renewables Programme.

Name	Position
Professor Maurice Beckett	Department of Community Health, University of Nottingham
Professor R.B. Clark	Department of Zoology, University of Newcastle
Sir Derek Ezra	Chairman National Coal Board
Brian Johnson	Fellow of the Institute for the study of International Organisations and of the institute of Development Studies at the University of Sussex and Director of the Ecological Foundation
Gerald Leach[118]	Broadcaster and Writer
Lord Llewelyn-Davies	Department of Architecture, London University
Professor R.C.C. Matthews	Chairman Social Science Research Council and Drummond Professor of Political Economy, Oxford
The Earl of March	Member of General Synod of the Church of England, Member Central Committee of World Council of Churches and Church Commissioner
Professor Kenneth Mellanby	Director Nature Conservancy Research Station, Monks Wood [now the Institute of Terrestrial Ecology]
Doctor Robert Murray	Medical Advisor to the TUC
Peter Parker	Vice-Chairman Court of London University, Vice Chairman Rockware Group Ltd and other business appointments [later Chairman of British Rail]
Sir Derek Pritchard	Past-President of Institute of Directors, Chairman Carreras Ltd, Director Midland Bank and other business appointments
Professor R.S. Scorer	Department of Mathematics, Imperial College
Sir Peter Scott	Honorary Director Wildfowl Trust, Slimbridge
Anthony Smith	Head of Zoology and Applied Entomology, Imperial College
Ralph Verney	Past President Country Landowners Association; Chairman D.O.E. pre-Stockholm working party on Management of Natural Resources
Dr Alexander King	Past Director General of Scientific Affairs of OECD

Figure 7.2.2 Table of 'Consultants as of June 1973'
Source: CAT Archive

[118] Gerald Leach, then the Science Correspondent for the Observer, had been introduced to Morgan-Grenville through Peter Harper who had met him at a conference he'd organised at Kings College in London in the summer of 1970 called 'Threats and Promises of Science' (Peter Harper, interview November 2005; Björk 1996).

However, this proposed return visit could not be recalled by Roderick James who proposes that it never happened[119]. This failure to return in some way reflects the political ambivalence to the development of renewables during the 1970s, an attitude that failed to go unnoticed by those attempting to engage wider political networks in the impending environmental crisis. Of Norman Lamont's visit, Roderick James recalls that it "was pointless and inconclusive and I think in spite of my stimulating company at our house in the mountains above Cemmaes (now a large wind farm!), it was purely political PR, so he could say he'd been"[120]. The UK Renewable Energy Programme had been launched in 1974 by the Labour Government in response to issues of energy resource availability highlighted by the 1973 oil crisis, with subsequent published reports on the potential of various renewable energy sources before the end of the decade (Elliott 1997)[121]. However, in its early years it received a great deal of criticism, not least from within Parliament. Reports by an all-party House of Commons Select Committee on Science and Technology in 1977 and 1984 commented critically on the way the Department of Energy had handled the renewables programme detecting "a certain complacency towards the development of new sources", commenting specifically on cuts to the funding of particular research and development programmes[122]. Immediately prior to its abolition in 1992, a Select Committee on Energy concluded that "it is difficult to regard the history of renewable R & D funding in the UK as other than a history of *volte faces*, premature judgements

[119] Roderick James, email correspondence 24/07/07.
[120] *Ibid.*
[121] See for example ETSU (1977), Select Committee on Science and Technology (1977a; 1977b), Energy Policy Division (1978)
[122] Renew On-Line 9, issue 108, Aug 1997 (http://eeru.open.ac.uk/natta/rol9.html#Down accessed 24/07/07)

and plain errors"[123]. Despite visits to the Centre, it would seem that this interest was somewhat superficial and Parliamentary decision-makers in the field of renewable energy continued to focus instead on the development of nuclear technology despite the conclusion by an ETSU Strategic Review that "in general, tidal power is roughly on a par with nuclear power in the benefit/cost ratios which it produces"[124]. Although CAT may have failed to induce in its Parliamentary visitors a serious commitment to the development of renewables, the visit fulfilled a purpose in superficially attributing a degree of socio-political legitimacy that Morgan-Grenville so fervently sought.

Perhaps however, the greatest socio-cultural endorsement came in the form of three Royal visits, firstly in October 1974 when the Duke of Edinburgh, escorted by Morgan-Grenville and trailed by a host of media, made a tour of the project (see figure 7.2.3). Prince Philip's interest was followed by what James called "a pointless visit" by the Duke of Kent in July 1975 following the opening of the visitors' centre[125]. Three years later in March 1978 Prince Charles also made a visit to the Centre (see figure 7.2.4) and according to James (in comparison to his fellow royal representatives) "was extraordinarily well informed about horizontal and vertical axis windmills, herbal remedies, wholefood cooking, organic farming and many other aspects. He was well ahead of his time"[126]. Prior to these visits Morgan-Grenville describes the status of the project as "hitherto a matter of disdain" (2001: 172).

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123 *Ibid.*
124 Energy Technology Support Unit, Department of the Environment. See footnote 122
125 Roderick James, email correspondence 24/07/07
126 *Ibid.*

However, the patronage of Prince Philip in the early years, followed by Charles several years later (who "knew more about the subject and probably had a considerably more useful effect"[127]) served not only to attract a great deal of publicity to the project but in doing so ascribed it a mark of credibility. This was acknowledged by the wider AT community itself, the news of the Duke of Edinburgh's visit to CAT causing *Undercurrents* editors to exclaim "Alternative Energy, until recently the almost-exclusive province of cranky eco-eccentrics, has become *respectable* with a rapidity that has taken most AT freaks' breath away"[128]. The visit of Prince Philip brought with it the media attention the centre required to propel it, albeit momentarily, into mainstream culture, and attributed to the project a seal of approval from the highest cultural authority which worked to elevate the standing of the centre and thus facilitate the dissemination of its environmental message.

Combined with those from both political and media representatives the Royal visit helped to bring the socio-political and cultural legitimacy to the project that Morgan-Grenville so fervently sought, commenting that towards the end of 1974 "the planners were turning out to be unexpectedly helpful and the media had stopped sniping" (Morgan-Grenville 2001: 178)[129]. Prior to these visits, Morgan-Grenville gave the following account of the media coverage:

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[127] *Ibid.*

[128] Ed., 1974, 'The princely pursuit of AT', *Undercurrents* 8, 1. The edition of *Undercurrents* in which the article appeared featured on its front cover a photograph of Buckingham Palace replete with superimposed roof mounted wind turbine.

[129] The media attention the project had received during its embryonic construction stages was sufficient to raise its visitor numbers increasing from 18 on 2nd July 1975 to 415 just over a month later on 8th August (1975 project diary 1975).

> Mostly uncomprehending and dismissive ... did not have to search hard at this early stage of our evolution for an 'angle' from which to present the shambles which met their cynical eyes. Designations such as 'scruffy hippies', 'environmental fanatics' and 'middle-class visionaries' formed the average level of comment. I came in for particular derision as soon as my hyphenated name and Eton and Army background was discovered: one journalist renamed me Mr Mournful-Windmill (Morgan-Grenville 2001: 172).

Significantly, Morgan-Grenville (2001) suggests that the level of scorn heaped upon the centre and upon him mainly came from those who he calls 'Establishment' figures. He recalls that he was seen as a class traitor by some of his peers, not least by the land owner John Beaumont by his outspoken opposition to nuclear power, a point of conflict which temporarily led to the two men falling out[130].

[130] This is documented in a series of correspondences between the two men in which Beaumont objects to the posting of an anti-nuclear leaflet by Ecoropa (CAT Archive).

Figure 7.2.3 Photograph of Prince Philip's visit in October 1974 escorted by Morgan-Grenville (far left)
Source: www.cat.org.uk[131]

[131] Accessed 27/07/07.

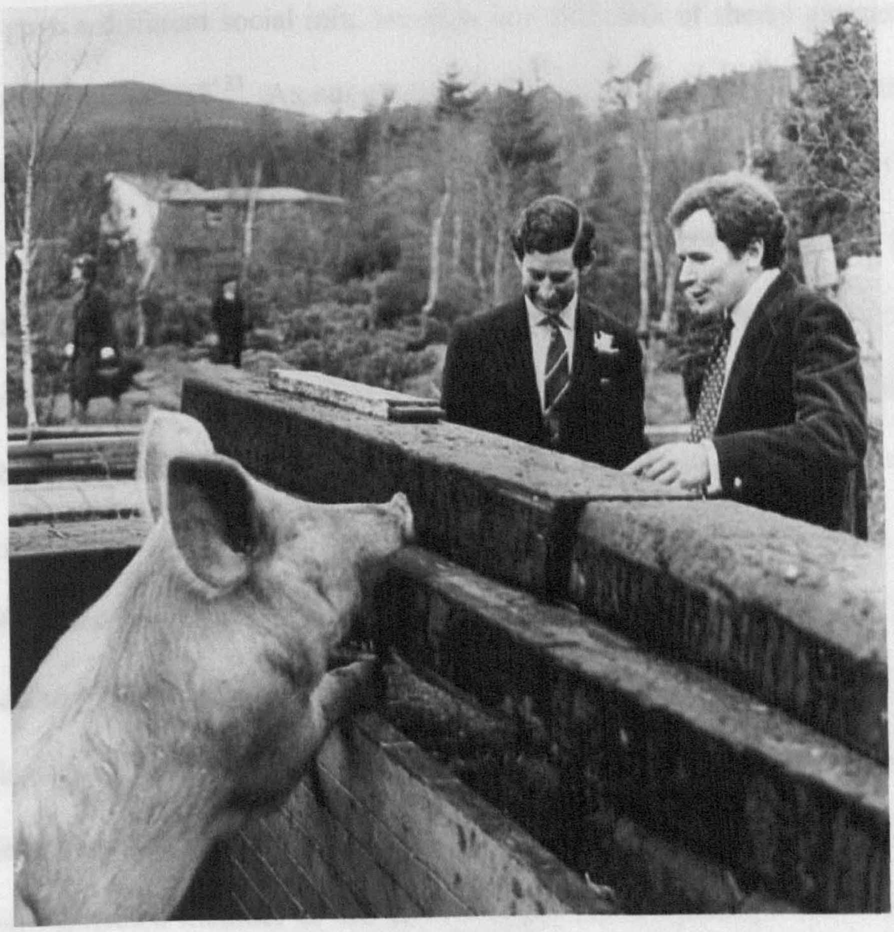

Figure 7.2.4 Photograph of Prince Charles with Roderick James during his visit to CAT in March 1978
Source: www.cat.org.uk[132]

The founder's position in the social hierarchy and the connections this afforded him undoubtedly assisted in the dissemination of the Centre's message and appeal. As Peter Harper reflects, "Gerard of course was very good at making contacts and being respectable; obviously he's very respectable and he can go and chat people up and they say 'ah, its not just a bunch of Hippies; we've got this old Etonian on the job and that's great'. So it was that difference between some other wild projects; it had this air of respectability, which was very good and it also attracted lots of 'green welly'

132 Accessed 27/07/07.

types so gave a different social mix. So there was the clink of sherry glasses as well as the rolling of joints"[133]. As suggested by Harper, it was this ingredient which enabled the project to access more conventional realms, notably those that were at the top of the social hierarchy, and helped to position it apart from other similar projects. It is notable that a similar project also came out of the 1972 Alternative Technology conference at the Bartlett School of Architecture at University College London[134]. The Biotechnic Research and Design commune, or 'BRAD' as it became known, was also set up in the vicinity of the Welsh borders in Shropshire but foundered early in its development allegedly as a result of internal conflicts[135], problems that had also threatened to jeopardise CAT had it not been for the personal qualities of Morgan-Grenville as well as the recognised contributions of James, Todd and the volunteers the project attracted. The fact that this similar project lacked the benefits afforded it by a well-connected member of the British upper classes perhaps rendered it more vulnerable to failure.

7.3 Gerard Morgan-Grenville and the Philosophical Paradox of 'Bridging the Gap'

At this juncture, further biographical analysis of the Centre's founder bears relevance. It is clear that well aware of the personal connections his privileged background afforded him, Morgan-Grenville used these to advance the message of

[133] Peter Harper, interview November 2005
[134] *Ibid.*
[135] Peter Harper, email correspondence, December 2005

the project, despite his obvious antipathy and ideological distinction from them. In order to bridge the gap, the environmental activist realised the importance of pragmatism in this pursuit. The ultimate goal of the project was the dissemination of the environmental message for which funds had to be secured. This meant that on some fronts political and ideological convictions had to be compromised, hence the list of Consultants (figure 7.2.2), on the surface of which along with a list of donors, which generally addressed certain construction and grocery requirements, was paradoxical to the ideology of the centre (see figure 7.3.1). This political ambivalence was noted by Martin Partridge on a visit to the Centre for *Undercurrents* magazine in 1977. In the report of his visit[136] he wrote:

> ...clearly the people at the centre are adept at riding two horses at once. The list of their commercial and industrial sponsors is a remarkable cross-section of the British capitalist Establishment, from ICI to Taylor Woodrow, over 130 names in all. This testifies to the prodigious fund raising efforts of the Society for Environmental Improvement, whose chairman, Gerard Morgan-Grenville said in *Undercurrents 8* that "people towards the top of the pyramid are vastly more effective in terms of what has to be done than people at the bottom of the pyramid – this is absolutely obvious." I mention this not in condemnation, since without financial backing very little could have been achieved, but in order to try to identify the political and economic pressures which operate at the Centre (Partridge 1977: 12).

[136] Partridge, M., 1977, 'CAT's cradle', *Undercurrents* 19, 11-13

Although he purported to reject the ideals of conventional society in particular the Establishment community to which he was so connected, Morgan-Grenville recognised a need for its approval as far as the promotion of the project was concerned. In order to bridge the socio-cultural divide and reach a wider audience he saw that he would need the endorsement of those positioned at the top of the socio-cultural hierarchy. Despite his acknowledgement of his class position this was something from which the founder had attempted to disassociate himself for most of his adult life (Morgan-Grenville 2001). Morgan-Grenville was so repelled by such Establishment ideologies and official bodies that the prospect of project the taking on this characteristic caused him to threaten to withdraw his direct involvement as, he did "not relate happily to scientific establishments nor to semi-official bodies"[137].

[137] 'Memorandum to permanent staff', 30th December 1974, CAT Archive

Acrow (Engineers) Limited
Associated Portland Cement Manufacturers Limited (Blue Circle Group)
British Berkfield Filters
British Rail
Buck and Hickman Limited
C A V Limited
Cuprinol Limited
Dexam International Limited
Everest Double Glazing Limited
Fibreglass Limited
Greenham Tool Company Limited, Imperial Chemical Industries
Kellogg Company of Great Britain Limited
Kock-Light Laboratories Limited
Sir Maurice Laing Limited
James Latham Limited
Lieut. Colonel Lloyd Williams
Lockhart Service Depot Limited, Joseph Lucas Limited
Sir Robert McAlpine & Sons Limited
Matthew Wrightson Limited
Mollett Catering Equipment Limited
Motto Food Company Limited
Nestle Company Limited
Prewett's Ready Mixed Concrete Limited
SGB Scaffolding (GB) Limited
Spear and Jackson (Tools) Limited
Staines Kitchen Equipment Limited
Taylor Woodrow Construction Limited
Turner and Newall Limited
R. Twining and Company Limited
United Biscuits Limited
Ven den Burghs and Jurgens Limited
Viners Limited
Whitworth Holdings Limited
Calor Gas Company Limited
British Steel Corporation

Figure 7.3.1 List of 'Industrial and Commercial Contributors'
Source: CAT Archive

The ways in which he sought to achieve his socio-environmental vision also conflicted with the wider ideology of the site. Although in part of its operation, i.e. as a community it was distinct from conventional organisations, in other ways it was in danger of simply duplicating them. This can be deduced from both the working practices and rhetoric of Morgan-Grenville himself. In various memoranda to permanent staff the founder speaks of the project's 'corporate philosophy', scheduling of the 'annual conference' and proceeding in an 'orderly and constructive manner'[138]. Given Morgan-Grenville's career history and experience of the commercial environment prior to the establishment of the project this type of language is unsurprising, but distinct compared to that of the permanent staff who communicated their ideas in more simple terms[139]. Furthermore, the connection of the project through Morgan-Grenville to more conventional groups worked to conflict with the overarching philosophy of the project which sought to detach itself from mainstream society. Through these connections, on some of which the Centre was ultimately dependent for its early survival, it remained inextricably linked to the wider political and cultural ideologies to which it was ostensibly opposed.

Despite an affiliation to the growing counter-culture of the 1970s and his anti-authoritarian feeling, Morgan-Grenville through his personal background, represented the very thing he sought to reject; what to him represented everything authoritarian. Despite this conflict, it is this paradox of an individual who straddled counter- and conventional culture that determined the success of the Centre; an

[138] Various documents, CAT Archive
[139] *Ibid.*

individual with both the environmental vision and the personal connections to bring these two worlds together. As those involved in the Centre's embryonic development will themselves admit, without Morgan-Grenville's personal connections, a function of his societal position, family background and upbringing, the success of the Centre would have been severely compromised[140].

Morgan-Grenville is retrospectively viewed by those who worked with him during the early years of the Centre as someone with vision, but more importantly someone who was able to realise that vision. Of Morgan-Grenville, Roderick James states that he demonstrated "a tremendous energy, a tremendous spark, he wasn't afraid to trample over social mores thinking in a different way"[141]. Like James, Morgan-Grenville was considered someone who was able to 'make things happen'; considered by his CAT peers as the environmental *visionary* without whose energy, enthusiasm and drive the project would never have survived in its early stages, thwarted as it was by so many physical, social but perhaps most significantly *financial* challenges. In considering his overall role in the project Morgan-Grenville summarises thus:

> I think my role in CAT was sort of multifaceted ... but I was there with a bit of money which was necessary to buy materials and get things going at the early stages, I was there with a fairly strong vision of how it should be: I had done quite a bit of homework because I'd travelled around; not everyone had been to America and

[140] Interviews with Bob and Liz Todd, November 2005; Peter Harper, November 2005; Gerard Morgan-Grenville, April 2007; Roderick James, April 2007.
[141] Interview with Roderick James, April 2007

places at that stage, it was much rarer than it is now ... I think I was probably quite a hard hitter at the Establishment which in itself wasn't of great importance then, except that it got publicity and publicity as every business person knows is the stuff of growth in a business. If nobody had ever come and the Press had never been there and Royalty had never been heard of and so on and so forth we'd have never got anywhere. I think I was able to introduce all sorts of elements to the thing. And one of the things I seem to have been quite good at was begging materials for the place[142].

Although Morgan-Grenville's social position and personal qualities rendered him an individual who was able to acquire resources, usually *gratis* or at a reduced rate, more than this it afforded him the necessary cultural, political and commercial connections which ultimately credited the project with the socio-political legitimacy it so desperately needed to ensure its success, without which, like others in the region, the project would probably have foundered in its early stages.

However, Morgan-Grenville's own reflections on the success of the project are attributed less to his external influences, and more to ingrained familial influences; values that had instilled in him a sense mutual respect, duty and above all hard work, something that he himself had found lacking in some of the cohorts affiliated to the alternative, or specifically 'Hippie' communities that he had met in the San Franciscan Hills[143]. Rather than a generic inclination of those brought up in a privileged environment, Morgan-Grenville states: "I think I was probably brought up

[142] Gerard Morgan-Grenville, interview April 2007.
[143] *Ibid.*

in a family that once they'd identified a problem intended to do something rather than sit and say what a problem it was. And so the fact that I sort of pushed off on my own to do something was, perhaps because of the environment that I lived in, not that surprising"[144]. Despite this interpretation, the experiences and opportunities that his social position afforded him undoubtedly contributed to the instilment of these qualities within him, and which always stood him apart from his CAT counterparts. As much as he consciously worked to position himself within, engage and interact with the wider counter-culture of the modern environmental movement, a culture which characterised the majority of the CAT community, ultimately, as reflected by his self-removal from the project, by virtue of his class and the experiences that afforded him, Morgan-Grenville would remain culturally distinct from the project.

7.4 The Growth of CAT

By the early 1980s, through increasing ticket sales CAT had established itself as an independent self-determining organisation operating primarily as a visitors' centre and through its formal volunteer programmes an educational facility[145]. The project employed in excess of thirty members of staff occupying an array of roles[146]. Exhibitions of alternative energy (and other) technologies continued to increase in

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[144] *Ibid.*

[145] By the end of the decade visitor numbers had reached around 55,000 a year (Quarry Association Newsletter, Summer 1980, CAT Archive) a vast achievement from the few hundred reported in its first year operation and testament to the increasing appeal of alternative approaches to society.

[146] Quarry Association Newsletter, summer 1980, CAT Archive. As well as positions in administration, the centre employed amongst others a Blacksmith, a Biologist, an Artist, an Educationalist, a Beekeeper, a Stonemason, a Carpenter and a Builder, roles that might be considered essential to a small-scale autonomous community.

number and diversity extending to alternative methods in construction, horticulture and animal husbandry as well as more complex displays of alternative energy production, specifically solar and wind, as the technology itself evolved, in addition to demonstrations of traditional crafts[147]. The educational remit of the project gained further significance through more formalised volunteer and educational programmes and the construction of a 300-seat Lecture Hall in 1979. The project also instituted a bi-annual newsletter for subscribers (*Quarry Association Newsletter*) through which it continued to disseminate its particular philosophy which by the late-1970s extended to ideas about family, medicine, education, labour and nutrition as well as the more central issues of energy and which also aided the procurement of much needed funds. The importance of the project as a research and development facility also continued to grow; In 1977, based primarily on the work of Bob Todd the Centre published its own national energy strategy *An Alternative Energy Strategy for the United Kingdom* (Centre for Alternative Technology 1977) which advocated a mixed fuel economy focused on renewables[148]. Despite the project's increasing significance reflected in an impressive visitor contingent, which in November 1980 was expected to rise to 60,000, the Centre continued to experience problems of funding, continually seeking to increase its Association membership, encourage visitor numbers and identify new sources of funding through government grants and other types of sponsorship[149].

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[147] *Ibid.*

[148] The publication cited serious disillusionment and scepticism of nuclear energy and its ability to avert an energy crisis, the "worst crisis civilisation has yet experienced" (Professor Sir Martin Ryle, Astronomer Royal, in CAT 1977: preface). Instead CAT placed emphasis on the conversion of energy from the sun, energy efficiency and the recycling of 'waste' heat in order to avoid "the large-scale development of the 'plutonium economy'" (*ibid.*).

[149] Quarry Association Newsletters, 1976-1980; miscellaneous correspondence, CAT Archive

In the summer of 1980 Roderick James announced his departure from the project for "many reasons, but broadly [he] felt that after six years the time had come for a change for the benefit of both the Centre and [himself]"[150]. A new Director was employed in the form of Peter Raine, a post-graduate conservationist (and former accountant) who had worked in a similar environment at Friends of the Earth in Birmingham and who had been a regular volunteer at the Centre since 1977[151]. Again, the policy of attracting those with a shared philosophy continued to be actively employed at the Centre. By this stage Morgan-Grenville had distanced himself from the project, remaining connected to it only through the charitable trust (SEI) through which it was first instituted. Today the founder remains a patron of the Centre, visiting on occasion and continuing to offer guidance and advice[152]. Through the Centre Bob Todd continued to explore and develop new alternative technologies into the closing decades of the twentieth century. Building on his academic links the engineer left CAT in the late 1990s to pursue his own engineering enterprise in the vicinity, although he retains close links with the project[153]. Despite their respective departures from the project, the ideology of the CAT project[154] remains with its most

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[150] Ed., Quarry Association Newsletter, Summer 1980, CAT Archive

[151] Raine had first visited the Centre at Easter 1977 and helped to construct window frames for one of the cottages on site (Quarry Association Newsletter, November 1980, CAT Archive).

[152] Gerard Morgan-Grenville, interview April 2007

[153] Along with Professor Douglas Kell of Manchester University, Todd established Aber Instruments in 1998. The company is largely concerned with biotechnologies (see www.aber-instruments.co.uk).

[154] Having interviewed Gerard Morgan-Grenville, Roderick James and Bob Todd in their respective residences, each have retained an element of the simplicity and to some extent the self-sufficiency they sought to promote through their respective involvement with the Centre. Morgan-Grenville now resides in a converted watermill in which the disused 1930s remains of a hydro-electric installation remain replete with head and tail race in the heart of rural Dorset; James in a converted and weather-boarded stone house on the banks of the River Dart in South Devon, attached to which is a timber-framed building resembling the structure of a medieval A-framed construction from where his timber-frame architectural firm now operates. Bob Todd and his wife Liz continue to reside in the abandoned farm house they purchased on their arrival at CAT which itself houses an electricity generator.

important colleagues, which is articulated perhaps most significantly through their domestic environments which demonstrate in different ways practical expressions of the ideas they sought to communicate three decades ago.

Although some of the initial objectives, primarily those relating to ideas of 'community', and the way the Centre functioned were ultimately compromised, a sense of egalitarianism was retained through particular practices, and the project in its demonstration of self-sufficiency through its growth was considered a success. Despite criticism from the alternative community that the project wasn't sufficiently political, it was through *practical* engagements with alternative technologies that its success was determined as through these exhibitions it was able to communicate a fundamental political critique. As Peter Harper confirms: "But of course it's that that survived; the practical. And the idea that you've got a place and you do it and you've got a continuing community that was actually doing it seemed to be the critical thing"[155]. Given the limitation of having to function within a cultural, economic and political environment that (even more so) resembled the character of the society it once so vehemently sought to reject, the compromise of some of these principles seems ultimately necessary in order to achieve its broader goals. Although the initial institution of the centre was characterised by an inchoate set of aims and objectives, the ways these were negotiated resulted in the organic evolution of the project, thus reflecting the very nature of the social, environmental and technical systems that the project advocated. In a celebration of its achievements, in 1985, 1995 and again in 2000 the Centre published its own written histories, further testament to its success

[155] Peter Harper, interview November 2005

where many of its counterparts which had embarked on similar visions in the 1970s had failed (see Brown 1985; Harper 1995 Centre for Alternative Technology 2000).

7.5 The Legacy of CAT

On taking over from Roderick James after his resignation in Summer 1980, the New Director Peter Raine said of the project that "the Quarry is more than just an exhibition and demonstration of alternative technology, in that it is a place that challenges the intellect and points the way forward for both personal and corporate growth ... and has a physical fabric that is the result of the commitment, hard work and love of many people"[156]. Despite an emphasis on alternative energy technologies, the CAT project embodied more than just a technocentric approach to the impending energy problem. Through these technologies the disciples of the modern environmental movement, the majority of whom were linked to a marginalised counter-culture, were able to communicate their wider philosophy, for the majority a reaction to the post-war world which through a policy of economic growth that advocated aggressive industrialism was seen as ultimately dehumanising and alienating and degraded both the environmental and social fabric of the world. Alternative Technology was therefore symbolic of a new way of understanding notions of Society and Environment. In this way CAT might be considered an approximation of early models of 'ecological modernisation', a concept with gathered pace from the early 1980s which sought to address environmental

[156] Quarry Association Newsletter, November 1980, CAT Archive

degradation through an emphasis on new configurations of technology and a critical appreciation of the role of the State (Mol and Sonnenfeld 2000).

The growth and success of the CAT project subsequently worked to alter its significance to the wider locale and has since been instrumental in shaping the character of rural mid-Wales. New approaches to Society and Environment continued to be the focus for many in pursuit of alternative lifestyles in the early twenty-first century, many of whom continue to orientate themselves in the rural landscapes of Wales, itself a legacy of the CAT project and its 'community'-orientated counterparts of the 1970s. Although the region undoubtedly adopted an 'alternative' quality prior to the arrival of CAT (which was itself integral to the Centre's geographical location), the establishment and subsequent activities of the Centre have further cemented the 'alternative' cultural and social character of some parts of Wales[157]. As Liz Todd explains, the Centre "spawned all sorts of little businesses of one kind or another: Dulas Engineering; and that spawned Aber Instruments ... it goes back to my point that the thing meant more than just a little project in the Quarry; it broadened right out to spread to significant companies that survived and I think that's made a huge difference to the character of the whole place"[158]. Not only have alternative energy engineering firms become established, but the 'alternative' culture has, arguably through the success of the Centre, not only survived but thrived in this

[157] CAT also stimulated the development of a similar project which focused more specifically on problems of energy in *urban* environments and with which CAT was directly involved. In its draft stages it was intended that like CAT, The Urban Centre for Appropriate Technology would operate under the umbrella of the Society for Environmental Improvement, by then a registered charity. Opened in the Bristol Docks in the early 1980s, it soon became independent of CAT but retained a strong organisation link.

[158] Liz Todd, interview with Bob and Liz Todd, November 2005

remote and peripheral region of Britain. Shops, eateries and other enterprises demonstrate a distinctly 'alternative' flavour, which reflects the character of the counter-culture which established itself here in the 1970s. The geographical peripherality of Wales somehow permitted the cultural exodus and permanent settlement of the Hippie culture which fostered the first endeavours to develop alternative energy as it is now understood in the twenty-first century. Place and purpose were inextricably linked in the foothills of Snowdonia.

7.6 Conclusion: Symbolic Landscapes of Technology and Power II

Like the case of the Worcester hydro-electric station considered in chapter 5, the in-depth exploration of the physical development and ideological underpinnings of the Centre for Alternative Technology illustrates how British landscapes of power in the context of renewable energy technologies were, a century later symbolic of an emerging socio-technical sensibility. Like those of the first hydro-electric schemes in Britain, the proponents of naturally renewing electricity supply systems in the 1970s embraced new forms of technology as means of moving forward, embracing technological change as a means of 'modernisation'. However, these respective technological models were wholly antithetical, the first pursuing increasing technological complexity, a tenet of technological systems which a century later was rejected by alternative technology practitioners in favour of increasing technological simplicity.

The renewable energy technologies pioneered at CAT were therefore a technological medium through which their proponents sought to modernise engagements with environment and society as a rejection of a prevailing societal condition which it saw as destructive of human and natural worlds. Although the project rejected technological complexity, itself synonymous with ideas of 'progress', this was a means of *ecological*-modernisation and looking forward for future survival in a potentially post-apocalyptic world. The expression of this new vision of environment and society necessitated a re-evaluation of nature and culture and as a corollary to those ideas, humankind's relational place therein, expressed through new cultural engagements with alternative landscapes of power.

During the infancy of the CAT project the successful application of alternative technologies and subsequent generation of energy was therefore, although not necessarily consciously, secondary to the communication of a new alternative socio-environmental philosophy. As discussed in 7.1.3 the primitiveness of the first renewable energy exhibits, despite their meagre success in generating electricity, were successful at communicating the environmental, technological and societal ethos, manifest at the Centre. In the current political climate in which discourses of environment, society and sustainability become ever more immediate, despite a necessary shift towards more conventional working practices, the symbolism of alternative technology as a means of communicating these ideals remains at the ideological core of the pioneering project.

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8 Conclusion

In exploring the historiographies of the development of hydro-electric power for public supply in the late-nineteenth century and explorations in the earliest pioneering forms of what might now be conceptualised as 'renewable' energy by the Centre for Alternative Technology in the 1970s, this thesis has considered historical engagements with naturally renewing power sources. In doing so it has both sought to understand these developments in the context of the distinct historical eras and British landscapes in which they were constructed and contributed to a cultural and historical geography of renewable energy in Britain.

Late-nineteenth century visions of environment through which small-scale hydro-electric schemes for public supply were developed connected to broader Victorian sensibilities of efficiency, order and thrift. The harnessing of waterpower for the development of hydro-electricity reflected a particular view of nature which was increasingly seen by an emerging professional elite as 'going to waste', a phrase which was commonly applied in reference to water resources. Notions of efficiency, waste and increasingly, order were also applied to the *aesthetic* of landscape as disused or otherwise 'idle' fragments were brought into (re)use. This was an environmental vision which embraced the developments of the recent technological era as a means of facilitating an ordered, efficient and controlled physical and social landscape. Significantly, the naturally renewing quality of water at this time was incidental to this process: water was just one of a number of possible energy sources which could be used, valued more in terms of utilising something which was otherwise 'going to waste' than something which was 'naturally renewing'.

By contrast, post-war visions of environment that fostered the development of renewable energy technologies during the 1970s were reflective of a broader environmental agenda which incorporated new conceptualisations of the social as well as the physical world. Engagements with 'alternative' energies during the post-war period of modern environmentalism were borne out of a re-ordered eco-philosophy which saw such practices as a means of restoring the close bonds between humanity and nature which were seen to be degraded by the mechanisms of post-war industrial society. Closer engagements with nature through simplified energy technologies were seen as an alternative means of human progress which drew on both past ideas and new techniques.

Despite the contrasts in the environmental visions that fostered these distinct engagements with naturally renewing energy technologies, several key commonalities can be drawn out. Having explored two distinct historical engagements with renewable energy through late-nineteenth century hydro-electric schemes for public supply and small-scale 'alternative' energy developments by CAT separately in the body of the thesis, this concluding chapter will thus attempt to draw out their similarities and reflect on notions of landscape, culture and technology during these two respective eras. In doing so it will also consider the way in which historical geographies of renewable energy both parallel and inform contemporary debates.

Hydro-electricity for public supply in the late-nineteenth century built on the technological revolution of the nineteenth century which produced both the turbine and incandescent lamp. These dual technological advances facilitated the introduction of an improved form of artificial lighting to its gas predecessor through a resource which was considered both 'cleaner' and arguably cheaper than its coal and gas competitors, an innovation which signalled a movement from a primary to a secondary energy source. Contemporaneously, the nineteenth century witnessed the development of a new means of local governance through the establishment of the Municipal Authority which as an expression of late-Victorian paternalism took charge of the supply of public utilities, including in addition to gas and water, electricity for the wider purpose of 'civic improvement'. The technologisation of Victorian society was thus applied to the supply of a public utility to bring about 'improvement' through the technological modernisation of society. Through these advancements a traditional source of motive power was transformed and subsequently modernised to create a new public amenity which would transform the way in which public and private space was utilised in both urban and rural environments. Late-nineteenth century hydro-electric development thus sought to capitalise on the new electricity and engineering technologies of the nineteenth century through new modes of governance as means of ushering in a new era in technological modernisation. For Victorian engineers this was not a rejection of what had gone before but a way to progress beyond this both technologically and metaphorically and thus achieve modernisation through improvement.

A century later, engagements with naturally renewing sources of power were borne out of a rejection of (what became) the technological orthodoxy the concept of which late-nineteenth century hydro-electric developments had once embraced. The institution of the Centre of Alternative Technology in the early 1970s was the practical expression of a counter-cultural movement which through a wider environmental sensibility sought to reject post-war western societal conventions and the economic and industrial infrastructures through which it had evolved and upon which it depended. Central to this reconstituted environmental ideology through which the emerging counter-culture was mobilised was a rejection of conventional energy technologies. Rather than a return to former societal conditions, the counter-cultural environmental ideology sought to borrow from and re-constitute the simplicity of former models of social order as a means of embracing the future, promoting a model of what Peter Harper recently described as '*neo*-primitivism' which sought progress through new configurations of conventional technologies[1]. In this way, certain post-war factions sought to reconceptualise society through a rejection of the means of modernisation that the Victorians had once embraced. Through its emphasis on new configurations of technology and a critical appreciation of the role of the State, CAT's new vision of environment and society unwittingly reflected certain characteristics of models of ecological modernisation that emerged in the early 1980s (Mol and Sonnenfeld 2000).

In order to achieve these respective models of societal change both looked to emerging and critically what were perceived to be *novel* forms of energy

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[1] Peter Harper, email correspondence, December 2005.

technologies, 'alternative' versions to contemporary conventional means, unique to the historical nodes during which they developed, which both utilised naturally renewing sources of power. As a new way of capturing a traditional source of motive power, hydro-electricity in the late-nineteenth century was considered by the civil engineers who both pursued and observed its development as extremely novel, even if they questioned its efficacy and cost-efficiency. However, unlike CAT's pursuit of energy from naturally renewing sources which developed these technologies *because* of their renewability, the utilisation of water (as a naturally renewing energy source) for hydro-electric power in the late nineteenth century was incidental to the novelty of the generation of electricity which both prefaced and monopolised late-nineteenth century discourses of hydro-electricity. By virtue of its rejection of the complexities, scale and industrialism of conventional energy technologies of the post-war era, particularly nuclear technologies, counter-modern environmentalists sought to develop simplified, small-scale energy generation methods, the antithesis to conventional means of electricity generation, appropriate to the social and physical environments in which they were situated. In this way they sought to develop 'alternative' technologies, a descriptor which has continued to be employed as a universal indicator of the energy technologies they pursued. Both for CAT and within more technocentric arenas, renewable energy technologies are now most commonly operated within a framework of ecological modernisation rather than within the small-scale, locally-controlled, 'alternative' vision that CAT once promoted. Perhaps as a more 'realistic' model of energy production, this vision has ironically now evolved to consider instead large-scale renewable energy generation as a feature of a wider ecological framework which, in conjunction with a policy of greater energy efficiency, offers a means of assisting in the reduction of global carbon emissions as well as providing a model of energy self-sufficiency which is now pursued on a national rather than a local scale[2].

Elsewhere, in the supporting chapters of the thesis, it has been demonstrated that during the middle years of the century practical expressions of renewable energy were characterised by large-scale structures developed for correspondingly large-scale regional supply purposes which reflected the modernist sensibilities of the inter- and post-war period. However, both late-nineteenth century and twentieth century examples of renewable energy considered within this thesis demonstrate that these engagements were both preceded and followed by contrastingly *small*-scale visions of energy generation. By virtue of their jurisdiction for local electricity supply, Victorian hydro-electricity generation was characterised by small architectural and engineering structures, often those that had functioned within existing local urban and rural economies as watermills. By contrast the counter-cultural environmentalist development of small-scale energy generators was borne out of a rejection of the technological complexities embedded within large-scale versions of renewable energy and the detriment they were perceived to effect on both the natural and social worlds as well as opposition to non-renewable sources of energy. Corresponding to an ecological philosophy which preached that 'small is beautiful' and sought to develop energy systems which facilitated self-sufficiency, counter-modern environmentalists focused on small, simplified structures with the capacity to supply only the dwellings and other buildings occupied by small, self-sustaining communities.

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[2] See www.zerocarbonbritain.com

Both the introduction of late-Victorian hydro-electric power and the institution of CAT were effected by particular cultural elites within the respective historical eras in which they developed. The nineteenth century witnessed the increasing professionalisation and rising status of the civil engineer, a product of the emphasis placed on technological modernisation during the nineteenth century. Through the development of hydro-electric schemes the scientific and thus professional knowledges of Victorian civil engineers were instituted to construct late-Victorian British landscapes of power. The institution of CAT also exemplified the production of landscape through elite knowledge. The project was the ecological vision of a wealthy upper-class well-educated entrepreneur with the social and cultural privileges that afforded him and was thus well situated to effect the institution of such a project which significantly, challenged the prevailing societal condition. As a product of an emerging ideology, particular ideas about the relations between society, nature and technology were imposed upon more traditional expressions of landscape. In this way both of these historical examples of engagements with renewable energy presented here were about the new constitution of emerging and established cultural authorities as much as the construction of landscape or engagement with renewable energies.

Having compared Victorian hydro-electric development and counter-modern environmental engagements with 'alternative' energies, the way in which they connect to contemporary debates might now be addressed. As the origins from which twenty-first century conceptualisations of naturally renewing energy sources stem, engagements with renewable energy at CAT connect in more obvious ways to current visions of electricity generation from naturally renewing sources which have come to be considered in terms of their *renewability*. Victorian forays into water-power however, demonstrate a less obvious connection to contemporary versions of environmentalism. Instead, as demonstrated above, the first examples of hydro-electricity connected to the expression of a different, decidedly Victorian environmental vision. However, on closer interrogation, similarities between the two can be drawn out. Late Victorian hydro-electric engineering unwittingly established certain traditions that now correspond to the modern-day environmental sensibility through the demonstration of both *re-use* and *localism*. The repeated examples of the re-use of abandoned industrial buildings and indeed the use of a naturally renewing resource itself illustrate the application of a moral and aesthetic vision of not letting things go to waste. In several of the schemes outlined above and especially at the installation at Worcester, it would seem that where possible engineers involved in electricity generation schemes used *what was already there*. Not only did this apply to locally available water power resources, but also to existing infrastructure through the *re*-use of abandoned mills and other industrial works. For most this was undoubtedly an economic decision which corresponded to the Victorian environmental aesthetic of efficiency and order: the use of water, a free source of energy, seen as otherwise 'going to waste' would reduce costs by negating the financial outlay for coal; the use of abandoned buildings would prevent their future dereliction. Furthermore the availability of these buildings, as existing industrial remnants, was often influential to the development of hydro-electric power.

Although for most the use of water drew on ideas about cost and waste, a handful of individuals, including engineers such as Sir Douglas Galton and Thomas Grierson, demonstrated, albeit unwittingly, a sensibility that might correspond to modern day expressions of ecologism: Both Galton and Grierson (see chapter 5) displayed such an (albeit embryonic) environmental sensibility through their opinions about energy production which held that the choice of motive power, be it coal-powered steam or water-power, should be determined by what resources were most abundantly available to the locality. Although it is likely that this sentiment ultimately stemmed from economic concerns, such individuals demonstrated the kind of localist sensibility that corresponds well to a twenty-first century environmental consciousness, where localism has become to some extent synonymous with ideas of environmentalism.

The model of both late-Victorian hydro-electric generation and the alternative energy technologies ideas pioneered at CAT in their relationship to notions of localism and re-use as well as the more obvious application of naturally renewing energy sources, connects quite consciously to the twenty-first century discourses of Environment and Society. In its central tenet of resource conservation both examples of electricity generation, despite antithetical social and environmental ideologies, conform to twenty-first century notions of sustainability, exemplifying two functional and practical models of energy generation through sustainable technological and environmental practices.

As noted above, through their respective renewable energy developments and use of existing structures, both examples demonstrate an interest in the re-industrialisation of abandoned or otherwise disused industrial sites, demonstrating how the dual sensibilities of 'efficiency' and 'thrift' were also applied to existing structures within the landscape. In the majority of cases late-nineteenth century hydro-electric generators were placed in existing industrial buildings, whilst the CAT project was developed on a disused quarry and revived dormant industrial mechanisms, first in the form of a narrow-gauge railway, swiftly followed by the integration of the site's reservoir to supply the hydro-electric installation from which the project derived the majority of its electricity supply.

Technological issues aside, the first hydro-electric schemes were also obstructed by political conflicts. As the only established source of artificial lighting by the late nineteenth century, the gas companies had achieved a monopolistic status and although the gas lobby was never fully able to prevent the establishment of its more popular successor, evidence shows that attempts were made within local political arenas to obstruct the adoption of electric light. Furthermore, the introduction of hydro-electricity for public supply in Worcester in particular demonstrates how late Victorian ideas of resource value were negotiated in a context of competing claims to water resources by different interested parties.

This latter observation points to evidence of a history of conflict within power generation debates over the construction of electricity generators and environmental resource use and amenity. Even the earliest forays into the smallest-scale public power generators prompted conflicts over competing rights to natural resources as conflicting agricultural, fishing and navigation interests were threatened by the construction of Worcester's hydro-electric station, an aspect which grew in magnitude and gravity with the ever-increasing size and significance of power stations into the twentieth century, thus illustrating the historicity of the intimate connections between environmental amenity and power generation, so familiar to contemporary discourses of electricity production. Although the precise claims to particular environmental resources may have changed, the potential for conflict over natural resources remains, thus demonstrating not only the historicity of British landscapes of renewable energy but also that of their nature as contested domains.

In addressing these ideas of scale as well as cultural conflicts over competing claims to natural resources, the changing environmental visions that fostered visions of renewable energy and the way in which they connect to ideas of national identity, the thesis connects through these themes (and others) to the wider academic literatures considered in chapter 2. In the context of local and regional energy generation, the thesis can be positioned within the wider academic literature as a contribution to cultural and historical readings of regional British landscapes. Within this broader sphere, through its consideration of late nineteenth century hydro-electric development and the activities of CAT as examples of engagements with *small*-scale energy generation, the research also offers new perspectives on landscape and energy which contribute to existing discourses of water, engineering and landscape.

This exploration of the past necessarily prompts questions regarding the relevance of these historical engagements with renewable energy not only to the wider literatures but also to present energy discourses and debates. The examination of late Victorian hydro-electric development and the institution of the Centre for Alternative Technology, illustrates a lack of recognition of the historical significance of these past engagements with renewable energy technologies within both the academic and wider literatures. Similarly a dearth of archival material for many of the hydro-electric schemes under consideration and the hitherto latent archive of CAT which until recently remained hidden in several cardboard boxes demonstrates the wider perceived significance of these histories. Evidence from Tucker (1976) in conjunction with visits to former sites of the first hydro-electricity supply systems also reveal the perceived historical significance of such schemes to the civic arenas in which their operation was once a central function, and a failure to commemorate the majority of these schemes is observed. This is particularly the case at Worcester where, aside from the original crest erected in masonry above the main entrance to Powick Mills (which are now used as executive housing), the site bears no other sign of the former hydro-electric station[3]. An exception to this rule is witnessed at Lynmouth where a small water-power installation demonstrating the early technology of the hydro-electric system which provided the small coastal resort with its first electricity supply serves as a museum to the significance of water-power to the town. However, these commemorations coincide with the more tragic local histories in which the natural force of water was witnessed with devastating effects as tens of people were killed and properties destroyed by the 1952 flood.

[3] A plan of the façade of Powick Mills which appeared in *The Electrical Engineer*, 14, 12th October 1894 attests to the originality of the stone.

However, unlike hydro-electricity generation in the late-nineteenth century, CAT has an arguably more enduring history and relevance to contemporary ideas of renewable energy. Considering the broader political legacy of the CAT project, the nature of the society in which it sought to articulate its eco-philosophy, one which continued to embrace industrialism, ultimately worked to restrict it to the realms of the counter-culture from which it had emerged and renewable energies continue to be considered as the *alternative* to conventional forms of energy production into the twenty-first century. As such the wider eco-philosophy of the project failed to ignite wider social and political imagination. However, political events such as the 1973 oil crisis meant that the model through which they attempted to articulate this ideology was successful in penetrating wider energy discourses in government and elsewhere as such engagements with naturally renewing sources signalled the beginning of a more critical approach to ideas about energy production (National Geographic 1981). Despite the announcement of its Renewables Programme in 1977 (Elliott 1997), government continued in its wider policy to pursue electricity generation from non-renewable sources until the 1990s when a greater emphasis was placed on the development of renewable energy sources, specifically wind energy, the Labour Government announcing in 2001 a 10% commitment to renewables by 2010 rising to 20% by 2020, emphasising predominantly Britain's wind-power resources (Department of Trade and Industry 2003). The sources of energy CAT advocated three decades prior were subsequently reclaimed by the State and ironically the centralised institutions the counter-cultural environmental movement sought to reject. Like their conventional fossil fuel counterparts, modern renewable energy generators have once again become large-scale, complex and thus according to CAT's terminology, 'mystified' and significantly, State-led. Contemporary discourses of renewable energy, characterised predominantly by large-scale on- and off-shore wind energy generation constitute a highly contested terrain as developments continue to be opposed on grounds of landscape and cultural disharmony informed by notions of (increasing) scale (Exeter Enterprises 1993; Burton 1996; Blowers and Elliott 2003). Furthermore, the impetus for the development of renewable energies stems from an altogether opposed ideology to that of the counter-cultural environmentalists, stemming from a *technocentric* rather than *ecocentric* ideology which holds that the environmental crisis can be mitigated through the application of technology without any alteration to wider societal and economic infrastructures. Despite an increasing focus on the energy sources CAT advocated in the 1970s, for those affiliated to the project at the time this remains insufficient, for example CAT's first Project Manager Roderick James who recently argued that "We still wait for a politician who has the courage to act even if it costs him/her their job"[4].

As discussed in Part I structures of renewable energy in the latter half of the twentieth century, in the form of large-scale post-war hydro-electric installations and late-twentieth century on-shore windfarms were the subject of vociferous opposition on grounds of landscape disharmony within what were considered traditional cultural landscapes. Large, imposing industrial structures were considered counter to notions of the rural to which ideas of size and scale (as well as those of national sovereignty) were integral. However, unlike their later counterparts, the objects of discourses of late-nineteenth century hydro-electric

[4] Roderick James, email correspondence 24/07/07.

development and those of engagements with 'alternative' energy generation in the 1970s were significantly devoid of these particular debates. Both examples produced significantly small-scale structures through which electricity was generated. In the case of late Victorian hydro-electric generation, engineering works were often housed in existing industrial buildings of similar size and design to their neighbouring domestic dwellings amongst which they were often nestled. Regardless of individual location, the re-use of existing structures many of which preceded others around them worked to effect a seamless integration of the emerging industrial technology. Similarly, the experimental 'alternative' energy generators pioneered by CAT in the 1970s by virtue of their purpose to provide sufficient energy for small communities produced small-scale domesticated structures, which despite an arguably more industrial aesthetic equally harmonised within their rural setting.

The thesis presents new histories of renewable energy which reveal different engagements with naturally renewing sources of power that offer alternative visions of landscape and technology based on small-scale, localised energy generation systems drawn from local resources for the supply of local needs. Through these reflections on ideas of scale the thesis offers potential new models for progress in renewable energy generation in the twenty-first century. The re-use of small-scale water-power generators in the form of watermills for hydro-electric generation has started to re-emerge, a trend that has been both recognised and advocated within academic engineering arenas (Hodkin 1999; Muller and Kaupert 2002). These re-engagements with traditional structures of renewable energy generation signal newly emerging forms of and engagements with water, engineering and landscape which are seemingly building on and seeking to reinstate historical engagements with renewable energy, thus illustrating the way that past visions of energy production have the potential to inform future engagements with renewable energy, not only raising further questions with regard to contemporary discourses of energy production, but also offering solutions to moving forward. The potential of these historical models of renewable energy generation in the context of discourses of landscape, technology and scale and more recent debates of British landscapes of renewable energy, to achieve landscape harmony, provides a future, more sustainable model for landscapes of power in Britain.

Contemporary ideas about renewable energy were thus borne out of competing environmental ideologies; one an ecocentric philosophy, a response to the increasing technical optimism which fostered the development of nuclear energy and response to environmental and social degradation; the other a more technocratic approach to resource availability, highlighted most starkly by the 1973 oil crisis. These two ideological pathways have subsequently resulted in two corresponding models of renewable energy; one through State-led research and development which corresponded to its earlier non-renewable counterparts and which now constitutes the primary notion of renewable energy; and another that advocates instead small-scale, *people*-centred systems. As demonstrated above, this model of local provision has recently begun to exert a wider appeal through the re-industrialisation of small-scale generators and the reinvigoration of industrial remnants, through the conversion of abandoned watermills to small-scale hydro-electric generators. Such is the relevance of this local community model of energy production to wider contemporary environmental discourses in the context of energy provision that, as illustrated in figure 8.1, large-scale providers have chosen to draw on these discourses, which encapsulate ideas of localism as a means of reflecting a seemingly ecological commercial consciousness and engaging politically with wider publics. The technological philosophy that CAT pioneered, three decades after its birth, has thus begun to take on greater national significance as the contemporary energy crisis threatens to escalate.

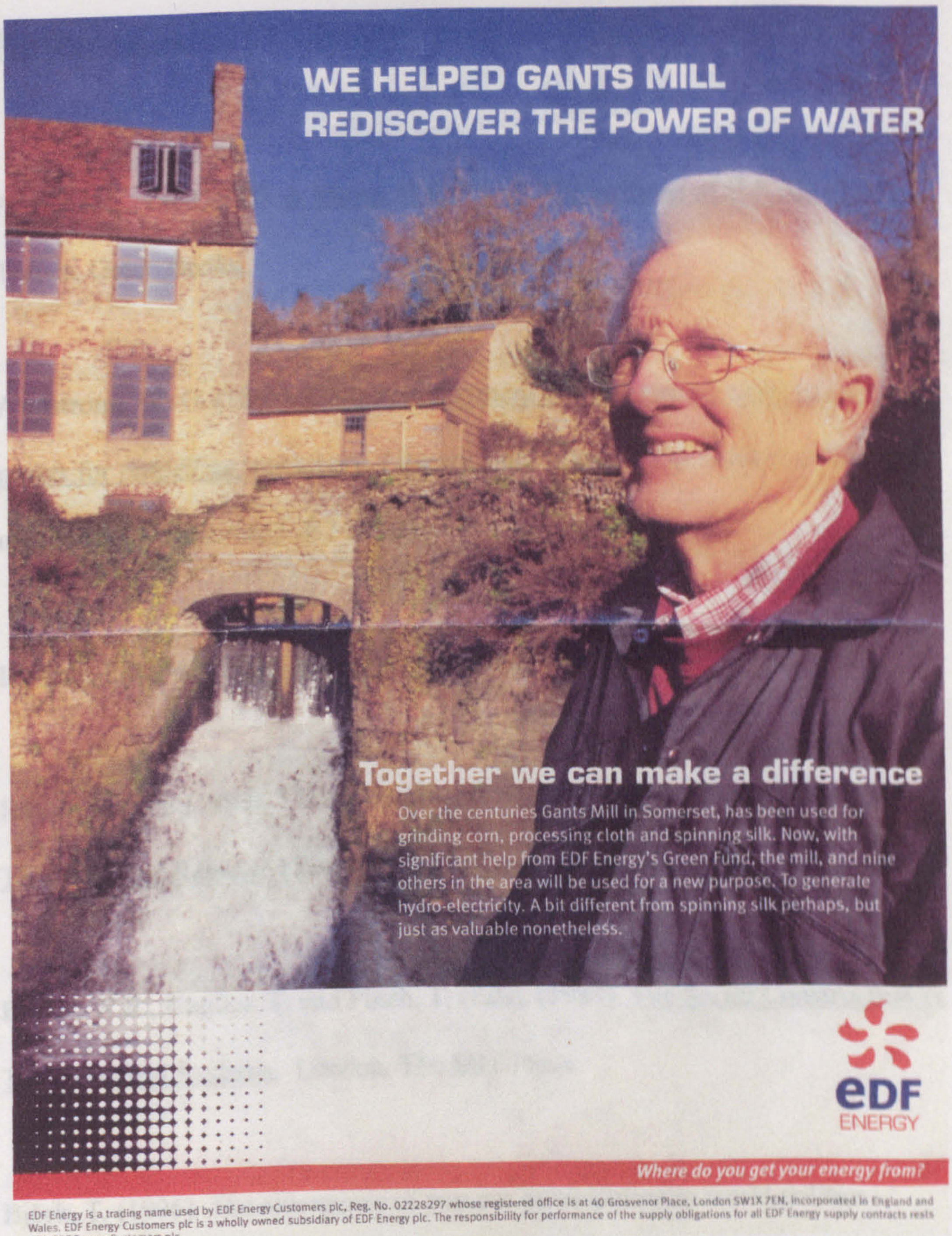

Figure 8.1 Advertisement by energy supplier EDF Energy for the re-use of watermills as small-scale hydro-electric generators
Source: The Observer Magazine, 4th March 2007

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