

**The Shropshire Enlightenment: a  
regional study of intellectual activity  
in the late eighteenth and early  
nineteenth centuries**

by

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# Abstract

The focus of this study is centred upon intellectual activity in the period from 1750 to c1840 in Shropshire, an area that for a time was synonymous with change and innovation. It examines the importance of personal development and the influence of intellectual communities and networks in the acquisition and dissemination of knowledge. It adds to understanding of how individuals and communities reflected Enlightenment aspirations or carried the mantle of 'improvement' and thereby contributes to the debate on the establishment of regional Enlightenment. The acquisition of philosophical knowledge merged into the cultural ethos of the period and its utilitarian characteristics were to influence the onset of Industrial Revolution but Shropshire was essentially a rural location. The thesis examines how those progressive tendencies manifested themselves in that local setting. The study therefore explores contemporary knowledge acquisition and dissemination, both within and beyond the industrial environment for which the county has become historically known. Comparisons are made with similar processes in other localities and conclusions drawn on local specificity in the context of economic and agricultural improvement and the enhancement of infrastructure. It acknowledges in the process, the cultural change effected in the lives of many individuals across the social spectrum.

# Acknowledgements

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# ABBREVIATIONS

MP	Member of Parliament
RCAHMW	Royal Commission on the Ancient and Historical Monuments of Wales
SDUK	Society for the Dissemination of Useful Knowledge
SNWNHS	Shropshire and North Wales Natural History Society



# Chapter 1: Introduction

## 1.1 Introduction

The pursuit of ‘improvement’ through the acquisition and application of knowledge conditioned many aspects of eighteenth and early nineteenth-century life. It became fashionable and it fired the dreams of the aspirational. For those with progressive convictions, it afforded the means to address and improve social, economic, agrarian and cultural dimensions of society. The period was encapsulated by the philosopher David Hume (1711-1776): ‘The spirit of the age affects all the arts; and the minds of men, being once roused from their lethargy and put into a fermentation, turn themselves on all sides, and carry improvements into every art and science.’<sup>1</sup> ‘Improvement’ as a cultural form is identifiable from the sixteenth-century onwards and it is this notion and the modern idea of an Enlightenment that provided the framework through which this study explores intellectual activity.

The study is centred upon the propagation of ideas, their accession and application, and the scientific exploration of natural phenomena by individuals and intellectual communities within Shropshire, an area of significant economic activity in Georgian England (see Image 1/1).<sup>2</sup> It also explores the positioning of that intellectual activity in a local social setting. It adds to understanding of how local communities reflected Enlightenment aspirations and thereby contributes to the debate on the establishment of regional Enlightenment. The acquisition of philosophical knowledge merged into the cultural ethos of the period and its utilitarian characteristics were to influence the onset of Industrial Revolution. That progress was nowhere better illustrated than in the west midlands in the latter half of the eighteenth and

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<sup>1</sup> Hume, D., ‘Of Refinement in the Arts,’ (1760), in Lenz, J. W., (ed.) *Of the standard of taste and other essays*’ (Indianapolis, 1965).

<sup>2</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000).

early nineteenth centuries. Peter Jones considers the region to have been a hub of international knowledge exchange, embracing intellectual enrichment through science and technical innovation.<sup>3</sup> The assimilation by individuals and groups, of scientific knowledge and the practical utilisation of that knowledge for the furtherance of technical and economic advance, established distinctive cultural footprints within the west midland economic region.<sup>4</sup> A constituent part of that region, Shropshire's location afforded connections with the Welsh borderlands, gave access through the River Severn to the major ports of the south-west and sat astride the principal overland route from London to Holyhead, the main embarkation point for Ireland.<sup>5</sup>

Since the 1980s the predominant emphasis in the study of the Enlightenment has been upon national contexts. Moreover its manifestations within regional and local contexts have received closer investigation. This thesis furthers the study of such regional variation and complements other published studies on regional Enlightenment.<sup>6</sup> The notion of distinctive Shropshire enlightenment, based on the activities of a group of men who functioned in a variety of social, commercial and professional environments, was advanced in 1983 by Barrie Trinder and more recently in a short journal article.<sup>7</sup> Some were innovative in their pursuit of technological improvement, either for commercial advantage or to promote the development of infrastructure. There were those whose religious callings or ethical beliefs engendered attempts to effect social advancement, others were medical men; some pursued personal interests in natural philosophy and the arts and others, to a greater or lesser degree, were

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<sup>3</sup> Jones, P. M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009).

<sup>4</sup> Sutton, G.V., *Science for a polite society: Gender culture and the demonstration of Enlightenment* (Oxford, 1995), p. 5; Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009), p. 8.

<sup>5</sup> Trinder, Barrie, *A history of Shropshire* (London, 1983, 2nd ed. 1998); *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000).

<sup>6</sup> For example: Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850* (Manchester, 2009); Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009); Robertson, J., *The case for the Enlightenment: Scotland and Naples 1680-1760*, (Cambridge, 2005).

<sup>7</sup> Trinder, B., *A history of Shropshire* (London, 1983, 2nd ed. 1998), p. 79; Trinder, B., 'Was there a Shropshire Enlightenment?', *History West Midlands*, vol. 1, No 1 (Spring 2013), pp. 26-29. Other articles within this journal have contextual interest.

motivated by fashionable determination. They included the ironmaster William Reynolds (1758-1803); the civil engineer Thomas Telford (1757-1834); Archdeacon Joseph Plymley (1759-1838), Justice of the Peace and anti-slave trade campaigner; the medical practitioner, Dr Robert Darwin (1766-1848) and the Shropshire land owner and JP, Rowland Hunt (1753-1811). The study explores whether their engagement can be explained on the grounds of enlightened behaviour or in terms of compliance with some form of prescriptive notion of Enlightenment ideals.

Existing studies of such intellectual activity within the region have largely centred upon Birmingham and on the Lunar Society members and their associates.<sup>8</sup> The cultural and economic implications of the acquisition and application of knowledge within the wider region have been largely neglected. Trinder writes extensively upon the history of Shropshire and highlights events and circumstances drawn upon in this thesis but he does not consider the nature and dynamics of intellectual activity within the county.<sup>9</sup> This project helps fill that gap through researching a period of economic and industrial growth in an area that was steeped in innovation: Shropshire and its economic and cultural hinterland. Better understanding of the regional intellectual context which helped forge those developments and shaped the history of Shropshire also flows from the research.

‘Enlightenment’ represents a convenient framework for considering the social, cultural and economic conditioning of the eighteenth and early nineteenth-century western world, but its attribution to all examples of progressive change is not appropriate. ‘Improvement’ offers an

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<sup>8</sup> For example: Jacob, M. C. and Stewart, L., *Practical Matter: Newton’s science in the service of industry and Empire, 1687-1851* (Cambridge, Mass., 2004); Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009); Money, J., *Experience and identity: Birmingham and the West Midlands, 1760-1800* (Manchester, 1977); Musson, A.E., and Robinson, E., *Science and technology in the industrial revolution*, (Manchester, 1969); Schofield, R. E., *The Lunar Society of Birmingham: a social history of provincial science and industry in eighteenth-century England*, (Oxford, 1963); Uglow, J., *The Lunar Men: The friends who made the future: 1730-1810* (London, 2002).

<sup>9</sup> For example: Trinder, B., *The Darbys of Coalbrookdale* (London, 1981); *A history of Shropshire* (London, 1983, 2nd ed 1998); *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000); ‘Ditherington Flax Mill, Shrewsbury- A re-evaluation,’ *Textile History*, 23 (2), (1992), 189-223; ‘William Reynolds: Polymath- A biographical strand through the Industrial Revolution,’ in *Industrial Archaeological Review*, XXX:1, (2008), pp 17-32.

alternative explanation. Research has sought evidence for a Shropshire Enlightenment and the thesis questions whether improvement and enlightenment were part of the same process of change: whether the notion of ‘improvement’ better defines the stimulus for innovation and progressive change.<sup>10</sup>

## 1.2 Literature Review

A collection of essays edited by Roy Porter and Mikulás Teich in 1981 changed the direction of Enlightenment study.<sup>11</sup> In exploring enlightened activity, the contributors broadened its geographic range from one primarily centred upon eighteenth-century France to one embracing forms identified across Europe and the United States. The current study is developed from that formative work. It examines the implications of intellectual activity on a local rather than national basis by setting out how beliefs were utilised by individuals within a particular social, cultural and geographic environment in the county of Shropshire. Thomas Munck challenges the concept of ‘national perspectives’ on the grounds that it is supportive of ‘parochialism and insularity,’ characteristics at odds with tenets promoted by early Enlightenment theorists.<sup>12</sup> However the local manifestation of enlightenment behaviour is not necessarily indicative of insularity, it exemplifies diversity. In supporting such a position, John Pocock argues that Enlightenment consists of a network of manifestations, with connected origins, an approach taken by this study.<sup>13</sup>

Peter Borsay believes that it was the cultural concept of improvement rather than Enlightenment that represents the better explanation for the instigation of contemporary change, a process which continued into the nineteenth-century.<sup>14</sup> In addition to which there were no political or philosophical determinants to improvement as is claimed by theorists for

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<sup>10</sup> Those two cultural forms are fully elaborated upon in Chapter 2.

<sup>11</sup> Porter, R., and Teich, M. (eds.), *The Enlightenment in National Context* (Cambridge, 1981).

<sup>12</sup> Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p. 3.

<sup>13</sup> Pocock, J., G., A., *Barbarism and Religion Volume 1: The Enlightenments of Edward Gibbon, 1737-1764*, (Cambridge, 1999), pp. 294-5.

<sup>14</sup> Borsay, P., 'The culture of improvement,' in Langford (ed.), *The Eighteenth Century* (Oxford, 2002).

Enlightenment. The tensions between the two concepts are exemplified throughout the thesis. A further alternative is broached in Chapter 2 in that it is possible that the combination of social, cultural and political factors prevailing in the Enlightenment period energised the pre-existing notion of ‘improvement.’

Local distinctions emerge from the study of regional and local examples of change promoted in the work of a number of historians, which mark the importance of such studies. Although not directly reflecting upon Enlightenment, Ian Inkster draws attention to the scientific community that established itself in Sheffield and the momentum created, through science lectures, the establishment of the Society for the Promotion of Useful Knowledge and the Mechanics’ Institution, in the transmission of knowledge.<sup>15</sup> Peter Jones examines the process of knowledge generation and exchange by the intelligentsia in Birmingham and the west midlands, a setting which in his view functioned, for a time, as a node of knowledge dissemination.<sup>16</sup> Paul Elliott writes on Derby and the role of science in its cultural development.<sup>17</sup> What becomes clear from these studies is that there are distinctions in the form of cultural development between different towns or wider regional localities: industrial towns such as Birmingham and Sheffield progressed differently and frequently for different reasons than county towns like Derby or Shrewsbury; and from each other. Elliott argues the importance of local philosophical societies in the cultural advancement of Enlightenment society but these were not ubiquitous and it seems that further studies are necessary to establish their importance in English Enlightenment.<sup>18</sup> Studies such as this contribute to completion of the mosaic of social and cultural history of the period.

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<sup>15</sup> Inkster, I., *Scientific Culture and Urbanisation in Industrialising Britain*, (Aldershot, 1997).

<sup>16</sup> Jones, P. M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009).

<sup>17</sup> Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850* (Manchester, 2009).

<sup>18</sup> Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850* (Manchester, 2009), p. 6.

Secondary texts provided contextual support for the substantive chapters and directed the attention to potentially relevant sources. Some were subject or chapter-specific: Charles Hadfield wrote on the canals of the West Midlands and the relationship between Thomas Telford and William Jessop in the construction of the Ellesmere Canal and this study tests some of the assertions made by Hadfield regarding decisions made during that contract.<sup>19</sup> Eric Richards and Ross Wordie have both written on the estate agent James Loch and the Sutherland estates, as more recently has James Bowen.<sup>20</sup> The chapters on agricultural improvement and infrastructure expand on their work, drawing out Loch's progressive attitudes, his commitment to improvement and the utilisation of intellectual communities and epistolary means to further advancement. Richard Hayman's thesis upon the Shropshire wrought-iron industry develops references within Trinder's *Industrial Revolution* on the Botfield archives.<sup>21</sup> He highlights aspects of knowledge transfer and makes a case for regional distinctiveness, which is a theme promoted in this thesis. Trinder's histories of the county provided an important framework of knowledge of contemporary events within the county.<sup>22</sup> The narratives do not analyse intellectual activity and its networks and this study serves to fill that gap: it presents a case for comparison with other local studies.

In exploring the influence of intellectual activity upon the progress of industrialisation it is necessary to acknowledge issues that determined the direction of development of 'philosophical' or scientific knowledge and consequently investigate the historiography of the subject. It has been initially useful to better understand the concepts of knowledge that are utilised by historians of science. In *Gifts of Athena*, Joel Mokyr sets out a definition of 'useful

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<sup>19</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.) and *Thomas Telford's Temptation: Telford and William Jessop's Reputation* (Shropshire, 1993).

<sup>20</sup> Richards, E., *The Leviathan of Wealth* (London, 1973); Wordie, J. R., 1982, *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982) Bowen, J., 'A landscape of improvement: the impact of James Loch, chief agent to the Marquis of Stafford, on the Lilleshall Estate, Shropshire,' in *Midland History*, vol. 35, No 2 Autumn, (2010), pp. 191-214.

<sup>21</sup> Hayman, R., *The Shropshire Wrought-iron industry c1600-1900*, PhD thesis, University of Birmingham, 2003; Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed. 2000);

<sup>22</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000); and *A History of Shropshire* (London, 1983, 2nd ed. 1998).

knowledge' that whilst challenged in some quarters, is generally understood and often applied. As he claims himself, 'the premise of this book is that what people knew affected what they did.' He also discusses the concept of an 'Industrial Enlightenment,' which he claims preceded and established the intellectual preconditions for Industrial Revolution. They are hypotheses that Jones, with particular focus on Birmingham and the West Midlands has tested and taken forward in *Industrial Enlightenment*.<sup>23</sup> Margaret Jacob and Larry Stewart offer contextualisation, embracing philosophical evolution, identification of those participating in the process and extensive evaluation of cultural implications that extend chronologically, geographically and thematically beyond the compass of this research project.<sup>24</sup>

This study complements these works by offering a different perspective. Although the geographical area under review did not incorporate major industrial towns, it contained significant industrial activity and the networks of propagators of intellectual and philosophical knowledge residing within the area were influential within both the region and wider sphere. One of the questions explored by the research confronts the development of technical innovation and how it sat within the context of intellectual activity in what was a largely rural county. The wider field of contemporary technical innovation is revisited by Mokyr in his 2009 book *The Enlightened Economy*, in particular Industrial Revolution and its relationship with Enlightenment. Although his end-point is its impact upon national economies, his interpretation of the dynamics involved has resonance with this study. Where this study takes a different approach is to consider the implications of such relationships at a local rather than

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<sup>23</sup> Mokyr, J., *The Gifts of Athena* (Princeton, 2002); Jones, P. M., *Industrial Enlightenment: Science, technology and culture in Birmingham and the West Midlands* (Manchester, 2009).

<sup>24</sup> Stewart, L., *The rise of public science: rhetoric, technology and natural philosophy in Newtonian Britain, 1660-1750* (Cambridge, 1992); Jacob, M. C., *Scientific culture and the making of the industrial West* (New York, 1997).

national level. Its synthesis of the historiography and the expressed opinions thereon, together with the hypothesis promoted make this a work of interest.<sup>25</sup>

The contextual background of Enlightenment and its cultural drivers are tackled through a range of secondary texts. Thomas Munck and Dorinda Outram provide modern studies offering general views of the age. Outram's synthesis of scholarship is supplemented by her own views on many Enlightenment issues.<sup>26</sup> Although it is studied as a global episode there are useful contextual elements to be drawn from it. Similarly with Munck, and although his analysis and conclusions are directed towards the social impact of Enlightenment across Europe it offers a comparative reference to what may be discovered as contemporary social imperatives and consequences of the cultural process in the Severn Valley. Withers offers a significantly different, albeit interesting perspective in addressing the influence of geography and spacial determinants on Enlightenment, which have some resonance with local studies.<sup>27</sup> John Robertson's perspective of recent scholarship seeks to exclude much of what has been contributed to the Enlightenment debate over recent years.<sup>28</sup> He contends that in essence the Enlightenment was a movement of intellectuals and not a 'culture of sociability' but it presents a well-argued balance to those making the case for 'national contexts,' as discussed in Chapter 2.

This study features local expressions of the pursuit of scientific knowledge within enlightened intellectual activity, and considers the cultural boundaries between Enlightenment and other cultural forms. In an appraisal of that interface Michael Brown challenges the 'taxonomic approach to periodisation' which inevitably obscures the dynamics of cultural expression, a

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<sup>25</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850*, (London, 2009).

<sup>26</sup> Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000); Outram, D., *The Enlightenment* (Cambridge, 2005).

<sup>27</sup> Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000); Outram, D., *The Enlightenment* (Cambridge, 2005); Withers, C. W. J., *Placing the Enlightenment: Thinking geographically about the Age of Reason* (Chicago, 2007).

<sup>28</sup> Robertson, J., *The case for the Enlightenment: Scotland and Naples 1680-1760* (Cambridge, 2005).

factor which is introduced into debates in Chapter 7. In the same volume Curran reflects on the contemporary empowerment of women writing within all literary genres.<sup>29</sup> The significance of the growth of observable intellectual activity amongst women conditioned elements of the research as is witnessed by the case-study incorporated in Chapter 6, which examines the studies of Katherine Plymley and Louisa Charlotte Kenyon into entomology and geology respectively. Those two friends epitomised not only the adoption of science by women located in a contemporary gentrified environment, but the influence their actions bore upon the education and cultural development of the young people in their charge.<sup>30</sup> The presence of women in narratives of Enlightenment science, education and knowledge accession is illustrated by Ruth Watts and Ann Shteir. Both enhance contextuality and the direction of enquiry.<sup>31</sup>

In order to establish a sound knowledge-base for research, reference is made to general texts relating to the development of Enlightenment science, works on specific aspects of that science and theoretical evaluations of the nature of scientific advance. Jurgen Habermas's *Structural transformation of the public sphere* remains highly influential, viewing the eighteenth-century emergence from state-influenced prescription or patronage of public science.<sup>32</sup> Amongst the texts accessed to provide overviews of the nature of advancement and direction of British science in the period, Marie Rowlands deals with West Midlands industrial structures in the lead up to Industrial Revolution whilst Dobbs and Jacob address the influences of Newtonianism.<sup>33</sup> They explore why English science culture took the form

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<sup>29</sup> Brown, M., 'Romanticism and Enlightenment,' in Curran, S., *The Cambridge companion to British romanticism* (2nd series) (Cambridge, 2010), pp. 34-56.

<sup>30</sup> Shropshire Archives, Ref: 1066/, Corbett of Longnor Collection, 'Katherine Plymley's Journals; Ref: 549/ 253-257, 'Diaries of Louisa Charlotte Kenyon.'

<sup>31</sup> Watts, R., *Women in science science: a social and cultural history* (London, 2007); Curran, S., (ed.), *The Cambridge companion to British Romanticism* (Cambridge, 2010, 2<sup>nd</sup> ed.); Shteir, A. B., *Cultivating Women, Cultivating Science: Flora's Daughters and Botany in England, 1760 to 1860* (Baltimore, 1996).

<sup>32</sup> Habermas, J., *The structural transformation of the public sphere* (Cambridge, 1989).

<sup>33</sup> Rowlands, M., *Masters and Men in the West Midlands metalware trades before the Industrial Revolution*, (Manchester, 1975); Dobbs, E. J. Teeter and Jacob, M. C., *Newton and the culture of Newtonianism* (New York, 1998).

that it did and how the accessibility of practical science flowed, ‘from the drawing-rooms of the elite to the middle-classes,’ to the point where engineers and artisans ‘addressed economic and technical choices with new sources of knowledge.’<sup>34</sup> An extension of that focus is provided by Inkster and Morrell but the case is presented from the perspective of social history rather than economic.<sup>35</sup> It acknowledges a thread that personal relationships were arguably more important in the engagement with philosophical enquiry than formal institutional membership, thereby supporting the relevance of networks in the local cultural environment.<sup>36</sup>

The most visible contemporary networks within the region are those associated with the Lunar Society and Schofield and Uglow deal with them at length.<sup>37</sup> Others reflect upon specific relationships and activities within its membership, to which end biographies of Priestley, Darwin and Keir explore the connections that existed between the Lunar friends and the subjects of this research.<sup>38</sup> Jan Golinski’s synthesis on the sociological aspects of eighteenth-century science is centred on key characters, namely Priestley, Beddoes and Davy and, for current purposes, highlights many of their relationships that are of particular interest. Golinski also makes a critical assessment of the means of dissemination of scientific knowledge that is entirely relevant to the conduct of this study.<sup>39</sup> Thomas Beddoes (1760-1808) was a Shropshire man. He was a doctor of medicine and an experimental chemist and had an interest in geology and botany, literature and progressive politics. Towards the end of the eighteenth-century he had established links with many of the Midland intellectuals and married Anna

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<sup>34</sup> Teeter Dobbs, B. J., and Jacob, M. C., *Newton and the culture of Newtonianism* (New York, 1998), pp. 89 & 111.

<sup>35</sup> Inkster I. And Morrell, J., *Metropolis and province: science in British culture, 1780-1850* (London, 1983).

<sup>36</sup> Teeter Dobbs, B. J., and Jacob, M. C., *Newton and the culture of Newtonianism* (New York, 1998); Rowlands, M., *Masters and men in the West Midlands metalware trades before the Industrial Revolution* (Manchester, 1975).

<sup>37</sup> Schofield, R.E., *The Lunar Society of Birmingham: a social history of provincial science and industry in eighteenth-century England* (Oxford, 2002); Uglow, J., *The Lunar men: The friends who made the future: 1730-1810* (London, 1963).

<sup>38</sup> Schofield, R. E., *A scientific autobiography of Joseph Priestley, 1733-1804* (Massachusetts, 1966); Schofield, R. E., *The Enlightenment of Joseph Priestley: a study of his life and work from 1733 to 1773* (Pennsylvania, 1977); King-Hele, D., *The collected letters of Erasmus Darwin* (Cambridge, 2007); Moilliet, J. L. and Smith, B. M. D., *A mighty chemist: James Keir of the Lunar Society* (n.a., 1982).

<sup>39</sup> Golinski, J., *Science and public culture: chemistry and enlightenment in Britain, 1760-1820* (Cambridge, 1992).

Edgeworth, daughter of one of the Lunar members.<sup>40</sup> Mike Jay's biography of Beddoes reveals the extent, structure and workings of those networks. A recent book that focuses on contemporary regional intellectual activities is Elliott's study of the East Midlands.<sup>41</sup> It provided references to subjects of mutual interest to this study and an opportunity to review how a directly related subject has been conceptualised and addressed.

The search for evidence of intellectual communities and networks has been conditioned by contemporary social, cultural and economic factors. Chapter 4 considers the degree to which intellectual activity within the area's communities influenced the progress of Industrial Revolution. Trinder's *Industrial Revolution in Shropshire* remains a key text for students and historians of the late-eighteenth century in the Severn Valley.<sup>42</sup> He traces the onset and dynamics of the Industrial Revolution, the influence of the Quaker ironmasters on industry and the social environment, and commercial, cultural and intellectual interests. Apart from the activities of the ironmasters he highlights the endeavours of John Fletcher, the vicar of Madeley, around whom an evangelical coterie emerged.<sup>43</sup> This reinforces the importance of faith-based communities in the study of eighteenth-century knowledge dissemination. The Darby family cast a long shadow over the history of eighteenth and early nineteenth-century industry and technical innovation, not least through Arthur Raistrick's seminal work, which is largely set against the background of eighteenth and nineteenth century Shropshire.<sup>44</sup>

Although stylistically this might now be considered hagiographic, he highlights their business activities, partnerships and people with whom they had significant association, their marriages and involvement with the Society of Friends. Raistrick's work is supplemented by Trinder's

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<sup>40</sup> Jay, M., *The Atmosphere of Heaven: the unnatural experiments of Dr Beddoes and his sons of genius* (London, 2009).

<sup>41</sup> Elliott, P. A., *The Derby philosophers: science and culture in British urban society, 1750-1850* (Manchester, 2009).

<sup>42</sup> Trinder, B., *The Industrial revolution in Shropshire* (London, 1973).

<sup>43</sup> Trinder, B., *The Industrial revolution in Shropshire* (London, 1973).

<sup>44</sup> Raistrick, A., *Dynasty of ironfounders* (London, 1953),

*The Darbys of Coalbrookdale* and Labouchere's *Abiah Darby*, which is based on the diaries of the widow of Abraham II.<sup>45</sup>

Knowledge of relationships or communities has been furnished by biographies. Richard Trevithick was one of the nation's foremost engine designers but he is of particular importance to this study through his the work at Coalbrookdale and at Hazeldine's in Bridgnorth and the people with whom he constructed his engines.<sup>46</sup> John Urpeth Rastrick had links to Trevithick, working at both Ketley and, as a partner, at Bridgnorth and in 1819 joined James Foster at Stourbridge. Foster's biography by Roy Peacock highlights the career of one of those men who took a new generation of engineering innovation into the mid-nineteenth century.<sup>47</sup> Douglas Ground's biography of Archdeacon Joseph Plymley recounts parish details from Plymley's visitations; his associations with industrialists and civil engineers, particularly in the production of his survey of the agriculture of Shropshire; and those members of Shropshire's compassionate community who joined the anti-slavery movement.<sup>48</sup> He also became a JP, thus broadening his already extensive connections. This work pointed the direction of further investigation, suggesting as it does the possible location of a Shropshire hub of knowledge exchange. Plymley's report on Shropshire agriculture brought together key figures in this research project: Thomas Telford, John Wilkinson and William Reynolds, as contributors to his report.<sup>49</sup> Agricultural innovation was an integral part of the intellectual progress towards Industrial Revolution not least because in the absence of an ability to feed the growing urban populations, industrialisation would not have continued at the pace that it

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<sup>45</sup> Trinder, B., *The Darbys of Coalbrookdale* (London, 1981); Labouchere, R., *Abiah Darby* (York, n.d).

<sup>46</sup> Burton, A., *Richard Trevithick: Giant of steam* (London, 2000).

<sup>47</sup> Peacock, R., (ed.), *James Foster of Stourbridge, 1786-1853: Industrialist and benefactor* (Kingswinford, 2006).

<sup>48</sup> Grounds, D., *Son and servant of Shropshire: the life of Archdeacon Joseph (Plymley) Corbett, 1759-1838* (Herefordshire, 2009).

<sup>49</sup> Plymley, J., *General view of the agriculture of Shropshire* (London, 1803).

did. Plymley's report, its contributors and Lord Dundonald's treatise drew together strands of industry, agriculture and intellectual development.<sup>50</sup>

Additionally, this thesis incorporates perspectives from a range of historical disciplines; economic and social history, histories of science and of material culture. Work within the latter field has frequently been founded on the view that the eighteenth-century acquisition of scientific knowledge reflected the contemporary growth of consumerism. It represented a fashionable diversion for many, rather than the pursuit of personal intellectual or economic advancement. McKendrick, Schaffer and Berg all offer perspectives on this hypothesis.<sup>51</sup>

Understanding the manner of knowledge exchange is important to the outcome of this research and several secondary texts are useful in this respect. Clark produced a widely-cited work on the subject of clubs and associations up to 1800 whilst Levere's transcript of the minutes of the Coffee House Philosophical Society offers a view of the proceedings of one of these ubiquitous establishments.<sup>52</sup> The search for the existence of both formal and informal associations of knowledge-exchange within the defined geographical area has been a key element of research undertaken. Isabel Rivers deals with the explosion of literary output in this period and gives insight into those acquiring works aimed at informing or stimulating intellectual activity.<sup>53</sup> Stephens and Roderick's collection of essays on early scientific and technical education also opens a window on how stimulation of interest in natural philosophy at an early age may have helped in its perpetuation through subsequent networks and

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<sup>50</sup> Dundonald, A. Cochrane, 9<sup>th</sup> Earl, *A treatise shewing the intimate connection that subsists between agriculture and chemistry* (London, 1795).

<sup>51</sup> McKendrick, N., Brewer, J. and Plumb, J. H., *The birth of a consumer society: the commercialisation of eighteenth-century England* (London, 1982); Schaffer, S., 'The consuming flame,' in Brewer, J. and Porter, R., (eds.), *Consumption and the world of goods* (Manchester, 1993); Berg, M., 'From imitation to invention: creating communities in eighteenth century Britain,' in *The Economic History Review*, Vol. 55, No. 1 (Feb. 2002), p. 1-30.

<sup>52</sup> Clark, P., *British clubs and societies, 1580-1800: the origins of an associational world* (Oxford, 2001); Levere, T. H. and Turner, G. L'E., *Discussing chemistry: the minutes of a coffee house philosophical society, 1780-1787* (Oxford, 2002).

<sup>53</sup> Rivers, L., *Books and their readers in Eighteenth-century England* (Leicester, 1982).

communal association.<sup>54</sup> The range of literature employed in this study helped formulate the direction of research, the lines of enquiry and questions to be addressed.

The history of Shropshire is dominated by the development of the county's iron trade and its pivotal role in the advent of Industrial Revolution. This thesis explores whether enlightened behaviour in Shropshire was limited to the advancement of industrialisation. It sets out to establish the form that intellectual activity took in Shropshire in the second half of the eighteenth and early nineteenth-centuries. A particular challenge arises in considering Enlightenment or improvement in the context of a diverse setting such as Shropshire and its economic hinterland, rather than that of one of the industrial towns. The area has a distinct social, cultural and economic footprint compared to Birmingham or Manchester, for example. Discrete geographical areas existed within the county in the shape of the East Shropshire Coalfield; the county town; and the rural areas with their landed estates.<sup>55</sup> Each reflected aspects of improving behaviour and although socially and economically connected, there were elements of specificity to each them, for example by way of timing or the nature of change. The thesis examines through thematic chapters and case studies, the influence of intellectual activity and personal association in infrastructure development, economic enterprise, agricultural improvement and cultural science, a structure which also largely accommodates the geographical settings outlined. They bring to the fore the adoption and evolution of each of those subjects within Shropshire; they point to similarity and disparity with other geographical locations and contemporaneity or timing variations of a regional nature. In Chapter 4, amongst particular questions upon which illumination was sought, were: 'To what extent was technological innovation that originated or was applied in Shropshire, the result of intellectual communion?' In addition the question asked how the pursuit of commercial

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<sup>54</sup> Stephens, M. D. and Roderick, G. W. (eds.), *Essays on scientific and technical education in early industrial Britain* (Nottingham, 1981).

<sup>55</sup> Trinder, Barrie, *A history of Shropshire* (London, 1983, 2nd ed. 1998), p. xv.

advantage sat within intellectual activity beyond the industrial areas, in what was a predominantly rural county. In Chapter 5: Agricultural Improvement, subject-specific concerns that were addressed consider how widespread was the engagement with agricultural improvement within the county; whether it was a reflection of overriding social and cultural issues such as fashion, commercial desire/ necessity, or social determination; what evidence existed of participation of local gentry with agricultural improvement; or consequently whether the estate agents, auditors or commissioners of landed estates, were the determinants of improvement or merely the facilitators. The study examines how intellectual development influenced the course of social, cultural and economic activity in the late-eighteenth and early nineteenth-centuries in Shropshire: it asks how intellectual activity that shaped the economic histories of the Severn Valley sat within the context of Enlightenment knowledge acquisition; whether opportunity existed for cross-disciplinary intellectual stimulation, as seen in such as the Lunar Society. There was, for example, an active anti-slavery movement within Shropshire at the end of the eighteenth-century, centred upon Joseph and Katherine Plymley, which attracted clerics, doctors, scientifically-inclined gentlemen, and prominent manufacturers to the cause.<sup>56</sup> It also considers the extent to which associational behaviour or what are referred to as ‘intellectual communities’ contributed to the promotion or enhancement of ‘improvement’ during this period; it seeks to determine to what degree intellectual networks were sustained by the exchange of letters; and asks whether those networks contributed to the process of innovation by means of their accession and transmission of knowledge. The thesis also explores the extent to which the existence of a Shropshire Enlightenment may have been conditioned by the acquisition and dissemination of knowledge.

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<sup>56</sup> Oldfield, J. R., *Popular politics and British Anti-Slavery: the mobilisation of public opinion against the slave trade, 1787-1807* (Abingdon, 1998).

### 1.3 Methods and sources

The juxtaposition between the cultural concepts of ‘enlightenment’ and ‘improvement’ represents another continuing theme. It considers whether they were part of the same process of change or whether a notion of ‘improvement’ better defines the stimulus for innovation and implementation of progressive change within contemporary Shropshire. Peter Borsay has argued that the concept of ‘improvement’ conditioned the British Enlightenment, although for the most part he addresses its cultural forms, giving somewhat cursory attention to the economic or social imperatives for change.<sup>57</sup> Similarly he has minimised the implications of scientific knowledge attainment and intellectual activity generally as conditioning influences, all of them important issues discussed within this thesis. The primary focus of the study rests upon contemporary *intellectual activity* and expressions of enlightened ideals, such as campaigning for the abolition of the slave-trade and the humanitarian treatment of prisoners which had their support amongst Shropshire progressives, have not been the subject of detailed analysis in this thesis for that reason.

The study also explores how networks of individuals, contributed to the processes of innovation by the application of acquired knowledge. It furnishes the opportunity to determine their constitution and the manner in which they may have influenced the advancement of knowledge or the progress of Industrial Revolution: how those familial, social, commercial, literary, philosophical, epistolary or faith-based connections, may have provided the conditions for intellectual processes to flourish or afford transmission of ‘useful knowledge.’ The manner in which links were sustained between individuals and groups and other dispersed philosophical circles is an element of this research. Those with social and business connections requiring travel, established personal contacts; individuals whose life-

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<sup>57</sup> Borsay, P., 'The culture of improvement,' in Langford (ed.), *The Eighteenth Century* (Oxford, 2002), pp. 183-212.

styles encompassed periodic residence in other parts of the country, created different circles of acquaintance; visitors to the region from home and abroad, including Samuel More (1726-1799), Secretary of the Society of Arts, the Italian philosopher Alessandro Volta (1745-1827) and Robert Fulton (1765-1815), the American engineer, engaged in the exchange of knowledge with locally based people.<sup>58</sup>

The dissemination of knowledge through epistolary connections represented an important avenue of contemporary discourse. In some contexts it bore the title of the ‘Republic of Letters,’ being, as Mokyr describes: ‘spontaneous networks of individuals across political boundaries who were interested in similar topics.’<sup>59</sup> Jones provides a different perspective upon the manner of its operation, declaring: ‘public and private spheres interpenetrated, and the Enlightenment quest for public knowledge would be pursued in tandem with information gathering for private pecuniary advantage...’<sup>60</sup> He explores the functioning of the Republic of Letters with particular reference to its utilisation amongst intellectuals within the region and he highlights its vulnerability to political events. But in the context of a widely regarded component of Enlightenment activity, contemporary correspondence involving Shropshire men during this period shows few signs of accession to the Republic of Letters in its prescribed form. This is not to deny that epistolary-based transmission of knowledge was important within the region, as the thesis examines the degree to which intellectual networks involving Shropshire people were effectively sustained by the exchange of letters. The correspondence between Charles Bage (1752-1822) and William Strutt (1756-1830) is a clear representation of a continuing two-way exchange of knowledge whilst James Loch’s (1780-

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<sup>58</sup> Allan, D. G. C., ‘More, Samuel (1726–1799)’, *Oxford Dictionary of National Biography*, Oxford University Press, Oct 2007; online edn, Jan 2008 [<http://www.oxforddnb.com/view/article/38826>]; Pancaldi, G. *Volta: Science and culture in the age of Enlightenment* (Princeton, 2003); Fulton, R., *A Treatise of the improvement of Canal Navigation exhibiting the numerous advantages to be derived from Small Canals...* (London, 1796).

<sup>59</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009), p. 37.

<sup>60</sup> Jones, P. M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009), p. 71.

1855) extensive legacy of letters, demonstrates his utilisation of the epistolary system to secure information and disseminate it to the greatest advantage.<sup>61</sup>

Diaries, travel journals and correspondence, have been extensively employed. To the knowledge of this author, the diaries of the progressive MP Robert Aglionby Slaney (1791-1862), the engineer John Urpeth Rastrick (1780-1856) and the travel journals of the Secretary of the Society of Arts, Samuel More (1726-1799) have not been used previously. Those of Katherine Plymley have been utilised by Joanne Dahn in a study on ‘women and taste’ but have not previously been employed in a context associated with the subject of this thesis.<sup>62</sup> Dahn’s thesis offers a perspective of Katherine and her life from the standpoint of the history of art.<sup>63</sup> It broadens the interpretation of events and contexts, drawing upon perspectives different from other disciplines. The journals present a picture of an Enlightenment woman who has an interest in cultural science and they introduce a range of people who visited, some of whom shared her interests in natural philosophy.<sup>64</sup> She records examples of intellectual communion, and the diaries contribute to one of the principal themes of this study, namely the establishment of the nature of intellectual activity in the period.

The correspondence between Charles Bage and William Strutt demonstrates the importance of letters in the dissemination of knowledge and the maintenance of intellectual association.<sup>65</sup> It is a significant component in the case study on Bage and Ditherington Flax Mill. Although utilised in part in 1962 by Skempton and Johnson, a detailed examination of the thirty-eight

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<sup>61</sup> Shropshire Archives, Ref: 6001/2657/1-38, Letters from Charles Bage to William Strutt; Staffordshire Record Office, Sutherland Collection, D593/K/1, Chief agent’s letters; Anita McConnell, ‘Bage, Charles Woolley (1751–1822)’, *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edn, Jan 2008 [<http://www.oxforddnb.com/view/article/76758>.]; Strutt, Jedediah, (1726-1797), *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edn, Jan 2008 [<http://www.oxforddnb.com/view/article/26683>.].

<sup>62</sup> University of Birmingham Cadbury Library, Ref: RAS/1/3, ‘The journals of R. A. Slaney’; Shropshire Archives, Ref: 6003/1-9, ‘R. A. Slaney diaries’; Shropshire Archives, Ref: MI4329- 1821, ‘Diary of J. U. Rastrick’; Ironbridge Gorge Museum Library, ‘transcription of Samuel More’s Diaries’; Dahn, J., *Women and taste: a case study of Katherine Plymley (1758-1829)*, unpublished PhD thesis, University of Wales, Aberystwyth, 2001.

<sup>63</sup> Dahn, J., *Women and taste: a case study of Katherine Plymley (1758-1829)*, unpublished PhD thesis, University of Wales, Aberystwyth, 2001.

<sup>64</sup> Shropshire Archives, Corbett Collection, Katherine Plymley’s Diaries, Ref:1066/.

<sup>65</sup> Shropshire Archives, Ref: 6001/2657/1-38, ‘Letters written by Charles Bage of Shrewsbury to William Strutt of Derby.’

letters from Bage to Strutt, some of which are undated, has resulted in a better sense of the progression of elements of empirical trials undertaken by Bage. The identification of previously unused archival material has also enabled changes to be made to Bage's biography.<sup>66</sup> James Loch's epistolary archive presents the image of a man with a sense of duty, reflective of the responsibilities seen by him, to fall to every person, dependent upon his/her position in society. His employment of correspondence and personal contact in the acquisition and dissemination of knowledge served the interests of his employer and furthered the progressive views he sought to advance. A number of historians have drawn upon this archive in respect of agricultural or social studies but it is believed that this is its first application in the field of Enlightenment studies or the history of knowledge.<sup>67</sup>

The bibliography of published works more than one hundred years old utilised in the thesis contains contemporary discourses, histories and promotional material and instructive texts by lecturers. Their course curricula and other printed ephemera are equally informative. They reflect the contemporary upsurge in production of material for intellectual consumption, encyclopaedia and informative works being popular with recreational philosophy enthusiasts, experimentalists and engineers alike.<sup>68</sup> Copies of such texts were frequently available only upon subscription and lists of subscribers are occasionally included within the volume, representing further source material of potential participants in acquisition of philosophical knowledge. A further aim of the thesis has been to add to the canon of local studies of the Enlightenment. Throughout, the research drew upon examples from other localities either by way of illustration, where extant records relating directly to Shropshire were not identified, or

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<sup>66</sup> See 'Chapter 5-Case Study-Charles Bage and Ditherington Flax Mill.'

<sup>67</sup> Staffordshire Record Office, Sutherland Collection, D593/K/1, 'Chief agent's letters;' for example, Richards, E., *The Leviathan of Wealth* (London, 1973); Wordie, J. R., 1982, *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982); Bowen, J., 'A landscape of improvement: the impact of James Loch, chief agent to the Marquis of Stafford, on the Lilleshall Estate, Shropshire,' in *Midland History*, vol. 35, No 2 Autumn, (2010), pp. 191-214.

<sup>68</sup> For example, Keir, J., *The first part of a dictionary of chemistry*, (1789); Martin, Benjamin, *Philosophica Britannica*, (1788); Hebert, L., *Engineer's and mechanic's encyclopedia* (1836).

as comparisons with circumstances prevailing in the county. Such parallels highlight the manner of local or regional variation as manifested in innovation or in economic and cultural forms.

#### **1.4 Conclusion**

Intellectual endeavour amongst inhabitants of Shropshire and its application in the pursuit of improvement are the focus of this thesis. There is recognition that however much there may have been a sense of connection for people with county structures they are artificial constructs. Such boundaries are permeable and knowledge flow and social association are not constrained by a line on a map. It is a device that is employed within the thesis to direct attention to an area that had particular economic, social and cultural characteristics that held the prospect of variation in contemporary paradigms.

Chapter 2 contains an analysis of the debates surrounding Enlightenment and improvement, and offers an alternative scenario to explain the drive for change. The following four chapters are those which cover the examination of substantive issues. Chapter 3 explores elements of infrastructure improvement that incorporate the employment of innovation and demonstrate the application of intellectual activity. The case study attached to the chapter deals with the construction of the Ellesmere Canal and the Pontcysyllte Aqueduct and highlights the association of engineers and craftsmen in the construction of the world's highest navigable aqueduct. The industrial dimension of intellectual activity is the subject of Chapter 4. Much of the chapter is devoted to the incidence of innovation within the iron industry and the contributors to change. Whilst the ironmasters are prominent actors, the case study focuses upon a different aspect of industrial innovation and that is the design of the world's first multi-storey iron-framed building, Ditherington Flax Mill by Charles Bage. The concept of 'improvement,' has been associated with agriculture back as far as the sixteenth-century and it

represents the subject in Chapter 5. Agriculture within the county was topographically constrained and contemporary references comment on its backward state. However change was observable and James Loch, chief agent to the Marquis of Stafford is the subject of the study associated with this chapter. A determined individual who sought to further the interests of his employer, he had progressive attitudes to the furtherance of change and the benefit of the unfortunate. His epistolary legacy represents an important source for this thesis. The final substantive chapter considers the engagement with cultural science. It examines the social spread of interest in scientific subjects and the manner of its dissemination. It affirms the existence of a desire to improve oneself and society and in this context the participation of women in scientific activity forms the subject of the chapter's case study.

This study is an examination of intellectual activity in the county of Shropshire; how it was conditioned by its locality, by its inhabitants, and by the progressive expansion of knowledge; how it manifested itself in infrastructure, economic growth, agricultural improvement and cultural expression. Its setting within a period defined as enlightened offers a framework of reference against which to make observations and to examine issues of local specificity. A continuous theme throughout the study is the juxtaposition between the concepts of Enlightenment and Improvement in respect of progressive attitudes to change and the following chapter provides a contextual analysis of the subject.

## **Chapter 2: Enlightenment and the Concept of Improvement- a contextual analysis**

### **2.1 Introduction**

Chapter 2 examines the conceptual issues surrounding Enlightenment and the notion of ‘improvement.’ It highlights some of the debates encompassed in Enlightenment scholarship and the ideals that define Enlightenment. It draws attention to the opinions concerning the duration of Enlightenment and its geographical boundaries. Considerations of Enlightenment in a national context, rather than in a European or global setting, have predominated in the last thirty years, particularly amongst economic historians and historians of science.<sup>69</sup> Much of the discourse has been directed towards the existence of an Enlightenment that prevailed in England and its distinction and timing compared with those in other places.

The concept of ‘improvement’ as a distinct social and cultural phenomenon in the eighteenth and early nineteenth centuries is also examined in this chapter. References to its application from the sixteenth to the nineteenth-centuries are presented and assessment of the extent to which the pursuit of improvement was conditioned by enlightened convictions is explored. Examples of the practical expression of ‘improvement’ within Shropshire are identified and in doing so draw out the relevance of knowledge development and its dissemination in social and economic progress.

### **2.2 Background to Enlightenment study**

There are a number of schools of thought on the nature, duration and philosophies of the Enlightenment, the most enduring of which places the centre of enlightenment thought in

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<sup>69</sup> For example: Porter, R., ‘The Enlightenment in England’ in Porter, R., and Teich, M. (eds.), *The Enlightenment in National Context* (Cambridge, 1981); Pocock, J. G. A., *Barbarism and Religion Volume 1: The Enlightenments of Edward Gibbon, 1737-1764* (Cambridge, 1999); Israel, J. ‘Enlightenment! Which Enlightenment?’, *Journal of the History of Ideas*, Vol 67, No 3 July 2006, pp. 523-545; Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009).

France between the 1740s and 1790s.<sup>70</sup> It is a literary and philosophical construct that acknowledges some formative influence from English writers such as Newton and Locke but recognises the shared values of philosophers in France, Germany and Scotland. In such a partnership France has primacy.<sup>71</sup> In 1981 Roy Porter and Mikulaš Teich revealed the potential for structural and geographical diversity within the Enlightenment with the publication of a collection of essays which led the way for a comprehensive reappraisal of its study.<sup>72</sup> This work based on ‘national contexts,’ encompassed the heterogeneity of social and political forms across the Western World and dampened the centrality of French literary and philosophical doctrine, in what has become a leading strand of academic Enlightenment endeavour over the last thirty years. Whilst the defenders of a single, French-dominated Enlightenment claim that England had no need for Enlightenment on the same terms as France, Germany and Scotland, due to the developed state of its political and social structures, ‘national context’ studies have nurtured theories of an Enlightenment that is particularly English.

Jonathan Israel argues that considering French *philosophes* as the principal determining influence on Enlightenment ‘underestimates the extensive philosophical and scientific borrowing all major eighteenth-century thinkers engaged in.’<sup>73</sup> However he also expresses the belief that to study Enlightenment on the basis of national phenomena denies the state of universality of knowledge and ‘common impulses’ which define the concept of Enlightenment. He makes a case for a single Enlightenment movement incorporating geographical differences in timing, but largely addressing the same intellectual issues: ‘Nothing could be more mistaken than to suppose that national arenas evolved in relative

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<sup>70</sup> Texts arguing this position include: Guy, P., *The Enlightenment: an interpretation* (London, 1967); Robertson, J., *The case for the Enlightenment: Scotland and Naples 1680-176* (Cambridge, 2005).

<sup>71</sup> For example, Robertson, J., *The case for the Enlightenment: Scotland and Naples 1680-176* (Cambridge, 2005), p. 41.

<sup>72</sup> Porter, R., and Teich, M., (eds.), *The Enlightenment in national context* (Cambridge, 1981).

<sup>73</sup> Israel, J. I., *Radical Enlightenment: Philosophy and the making of modernity, 1650-1750* (Oxford, 2001), p. v.

isolation from each other or that national contexts were decisive in shaping the broad pattern of intellectual development.<sup>74</sup> Certainly few who espouse the cause of national influences would deny the imprint of one set of enlightenment paradigms on another: to deny that national context influenced the speed and direction of enlightenment development is inappropriate.

There are a number of historians whose views occupy the space between a rigid dogma of 'national contexts' and the single French-dominated embodiment of Enlightenment. For example John Pocock argues for a 'pluralising Enlightenment' consisting of 'a number of movements in both harmony and conflict with each other.'<sup>75</sup> He contends that 'such arrangements did not necessitate the location of *philosophes*,' and challenges the traditional representation of the Enlightenment, declaring: 'I have no quarrel with the concept of Enlightenment; I merely contend that it occurred in too many forms to be compromised within a single definition and history, and we do better to think of a family of Enlightenments, displaying both family resemblances and family quarrels.'

It is in such an environment that progressive and economically developing states or regions can be seen to be functioning, particularly when we track the activities and motivation of individuals or their networks. If one follows the supposed prerequisites for the existence of Enlightenment, certainly the French-centred model, then the absence of philosophers of substance in England in the latter half of the eighteenth century would be injurious to claims of an English Enlightenment. But Robert Darnton refutes assertions that most of the French *philosophes* were, in general, producing original thought in the pursuit of change. Rather they were re-processing existing ideas with vigour and drive, courting the rich and the influential

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<sup>74</sup> Israel, J. I., *Radical Enlightenment: Philosophy and the making of modernity, 1650-1750* (Oxford, 2001), p. 137.

<sup>75</sup> Pocock, J. G. A., *Barbarism and Religion Volume 1: The Enlightenments of Edward Gibbon, 1737-1764* (Cambridge, 1999), p. 9.

and combining together in the furtherance of sometimes disparate goals.<sup>76</sup> He suggests that their ideals were based on ‘*idées-forces*,’ ideas subsumed in the reservoir of aspirational knowledge available to all educated people and that the influence of Enlightenment *philosophes* arose from the sense of purpose that they provoked.

### **2.2.1 Ideals of Enlightenment**

Much of the work on Enlightenment has been directed towards the identification of a corpus of beliefs or ideals at the heart of Enlightenment. The establishment of a range of distinctive characteristics owes much to the adoption of diversity as the principal Enlightenment credo amongst current scholars. Those who maintain the belief in a single, French-dominated form invariably deny the role of variation in Enlightenment culture, which advances the argument that what was happening in Paris was not the same as was taking place elsewhere. The improvement in communication between the last quarter of the seventeenth century and the second quarter of the nineteenth, apart from brief periods of hiatus, increasingly enabled the transfer of knowledge and thought and allowed the adoption of political, cultural and economic influences.<sup>77</sup> Manifestations of Enlightenment were not always contemporaneous in their development; they shared ideals but not necessarily exclusively. Joel Mokyr contends there were three strands to Enlightenment: the creation of an improved society; rational thought and an understanding of nature; and improvement of economy in order to enhance economic welfare.<sup>78</sup> The issue of the elimination of formal religion was a fundamental concept aligned to ‘*la siècle des Lumières*’ in France. It was not, however, of significance in contemporary English, Scottish or German Enlightenment thought, given the established

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<sup>76</sup> Darnton, R., ‘The case for the Enlightenment: George Washington’s false teeth,’ in *George Washington’s false teeth: an unconventional guide to the eighteenth century* (London, 2003), p. 7.

<sup>77</sup> See Jones, P. M. *Industrial Enlightenment: Science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2008); Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p. viii.

<sup>78</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009), p. 30, citing Rorty, R., ‘The continuity between the Enlightenment and ‘Postmodernism’ (Stanford, 2001), p. 19-36.

religious structures, prevailing alternative faith choices and the prominent contribution of religious figures in the pursuit of contemporary Enlightenment ideals. This is exemplified in the attendance of fourteen ordained ministers at a meeting of the ‘Society for Effecting the Abolition of Slavery,’ in Shrewsbury on 13 June 1791, together with Quaker ironmasters Richard, William and Joseph Reynolds.<sup>79</sup>

John Robertson, however, declares that Enlightenment was not just the adoption and expression of ‘common aspirations and values,’ it was ‘the commitment to understanding, and hence to advancing, the causes and conditions of human betterment,’ a sentiment echoed by Munck.<sup>80</sup> That represents a structural fault in the case for a single French-based form of Enlightenment. Voltaire reflected the views of a number of the *philosophes*, declaring himself to be uninterested in enlightening or emancipating the man in the street, his coachman or any other ‘servants.’<sup>81</sup> The association of Enlightenment solely with the ideas of a few intellectual theorists, without direct linkage between theoretical discourse and practical application, seems to confound the principles of Enlightenment to promote the advancement of the human condition. Kant explains that it ‘is the process of discovery, the active and critical engagement of the individual, that mattered, not necessarily the end result.’<sup>82</sup> It is a notion reflected upon in a number of instances in the following chapters. The irony is not lost on Munck that even Kant and his contemporaries found no common consensus regarding the scope of Enlightenment.<sup>83</sup>

In comparing events in contemporary Shropshire against Enlightenment ideals, the scope of technical innovation is notable specifically with regard to ‘the enhancement of economic

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<sup>79</sup> Shropshire Archives, *Shrewsbury Chronicle*, 13 July, 1791.

<sup>80</sup> Robertson, J., *The case for the Enlightenment: Scotland and Naples 1680-1760* (Cambridge, 2005), p. 28; Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p. 7.

<sup>81</sup> Israel, J. I., *Radical Enlightenment: Philosophy and the making of modernity, 1650-1750* (Oxford, 2001), p. 528.

<sup>82</sup> Quoted in Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p. 7.

<sup>83</sup> Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p. 7.

welfare’ and Kramnick asserts that the intellectuals of Western Europe supported economic advancements through commercial and industrial development, viewing it as a ‘progressive and reforming force.’<sup>84</sup> The Enlightenment commitment to the enhancement of understanding is also brought to bear in this context and Mokyr’s work on knowledge and Industrial Enlightenment inform the direction of this study. In terms of context he declares ‘useful knowledge was central to the British Enlightenment’ but the ‘Enlightenment concept of ‘usefulness’ involved both practical uses (that is technology) and a moral and intellectual improvement of humanity so that people could be taught more virtuous lives.’<sup>85</sup>

### **2.2.2 Debate over Duration**

Debates over the duration of Enlightenment have long endured, generally conditioned by the structural hypothesis adopted by individual protagonists. Favoured timeframes for onset, range between the 1680s and 1740s and that of termination from 1790 to 1840. Thomas Munck’s period of choice for the Enlightenment lies between 1721 and 1794. He determines that the publication of Montesquieu’s *Persian Letters*, in 1721 identifies a time when the crystallisation of certain ideals became accessible in print and influenced the direction and ambition of Enlightenment thought. His terminal year, 1794, witnessed the French Revolution make its most significant change of direction, added to which the death occurred of two of the most important late-Enlightenment *philosophes*, Condorcet and Lavoisier. But despite these acknowledged milestones, Munck declares that his defined period of choice is largely ‘a convenience’, given well-founded alternative claims: ‘Chronological markers or periodisation should not be allowed to obscure enlightenment issues that arise within the seventeenth or nineteenth centuries.’<sup>86</sup> It is an observation that has resonance in this study given the variable

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<sup>84</sup> Kramnick, I. *The Portable Enlightenment Reader* (London, 1995), p. ix.

<sup>85</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009), p. 35.

<sup>86</sup> Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p. vii.

timeframes associated with aspects of economic, social or cultural improvement in Shropshire.

In France in the 1680s, the Edict of Nantes was revoked and Bayle and Fontenelle were seeing their writings published, precipitating debates that are considered to have been the forerunner of *Lumiere*.<sup>87</sup> Kramnick views the Glorious Revolution of 1688 in England, with its institution of religious tolerance, to signal the onset of Enlightenment and determines its conclusion to be the turn to romantic conservatism following the revolutionary fervours of the last quarter of the eighteenth-century.<sup>88</sup> John Robertson considers the period prior to 1750 as a pre-conditioning influence in Enlightenment terms, which shaped the nature of the Enlightenment which came subsequently.<sup>89</sup> His case for an Enlightenment rests in the period from the 1740s to 1790s. He maintains that it was driven by the desire to achieve ‘betterment in this world.’<sup>90</sup> The direction of enlightened intellectual activity was to be concentrated on the process of improvement and not the removal of obstacles put in its way by religious dogma. Darnton’s view on the movement and period sits between the extremes and reflects that ‘The Enlightenment was an eighteenth-century phenomenon, but it produced a set of values that extended into following centuries.’<sup>91</sup>

For this study, centred as it is on the exploration of examples of progressive activity around Shropshire and the Severn Valley, there are a number of determining factors in establishing the period to be examined. Along with other provincial areas, mid-eighteenth century Shropshire witnessed the influence of greater acquisition and dissemination of scientific and technical knowledge and the results of innovation, much of which contributed to the onset of

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<sup>87</sup> Kramnick, I. *The Portable Enlightenment Reader* (London, 1995), p. x.; Israel, J. I., *Radical Enlightenment: Philosophy and the making of modernity, 1650-1750* (Oxford, 2001), p. v;

<sup>88</sup> Kramnick, I. *The Portable Enlightenment Reader* (London, 1995), p. x.

<sup>89</sup> Robertson, J., *The case for the Enlightenment: Scotland and Naples 1680-1760* (Cambridge, 2005), p. 7.

<sup>90</sup> Robertson, J., *The case for the Enlightenment: Scotland and Naples 1680-1760* (Cambridge, 2005), p. 7.

<sup>91</sup> Darnton, R., 'The case for the Enlightenment: George Washington's false teeth,' in *George Washington's false teeth: an unconventional guide to the eighteenth century* (London, 2003), p. 11.

Industrial Revolution.<sup>92</sup> In the mid-1750s this was symbolised by the formulation by Abraham Darby II of a process utilising coked coal rather than charcoal in the founding of cast iron deemed suitable for forging into wrought iron.<sup>93</sup> 1750 is consequently utilised as the commencement date for the study. Enlightenment activity or expressions of enlightened concern are visible in Shropshire into the nineteenth-century. Much of the progressive improvement in agriculture was not engaged with until after the first decade of the century and continued until the ‘high-farming’ period of the 1840s and 1850s. With the exception of the slave trade campaigns of 1790/1, expressions of humanitarian regard for social circumstance became more discernible beyond the turn of the centuries. Accordingly, explorations of potential Enlightenment behaviour continued until 1840.

### **2.2.3 Boundaries of Enlightenment**

The issue of boundaries, both geographical and structural, is a pervasive theme in modern Enlightenment studies, which is applied in either the advancement or defence of particular structural arguments. Isaac Kramnick supports the view that despite traditional representations of Enlightenment being based on the writings of French *philosophes*, it was a movement that was not constrained by national borders.<sup>94</sup> John Robertson notes competing claims wrought by historians of science and literary scholars for inclusion into the realm of Enlightenment. He claims the extension of the boundaries of Enlightenment to accommodate diverse interests leads to lack of ‘coherent, distinctive, intellectual identity.’<sup>95</sup> One suspects that it may lead to the loss of a narrowly defined identity but not an intellectual identity. Enlightenment was formed on intellectual activity and its intellectual identity emerges from enquiry into geographical and intellectual boundaries. Efforts to define the nature and extent of

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<sup>92</sup> Trinder, B., *The Darbys of Coalbrookdale*, Phillimore (London, 1981); Trinder, B., *A history of Shropshire*, Phillimore (London, 1983, 2nd ed 1998); Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973); Mokyr, J., *The gifts of Athena* (Princeton, 2002).

<sup>93</sup> Raistrick, A., *Dynasty of ironfounders* (London, 1953), pp. 68-69.

<sup>94</sup> Kramnick, I. *The Portable Enlightenment Reader* (London, 1995), p. ix.

<sup>95</sup> Robertson, J., *The case for the Enlightenment: Scotland and Naples 1680-1760* (Cambridge, 2005), p. 16.

Enlightenment continue to occupy historians: its core values and defining influences all coming under scrutiny and being variously incorporated in one hypothesis or another. The emergence of ‘national contexts’ within the debate on the geographical scope of Enlightenment have rendered any consensus beyond those broadly accepted within functional disciplines, unlikely in the short term. As discussed earlier, similar divergence of opinions reigns over the chronological duration of the Enlightenment. Munck argues that even with the volume of work undertaken in economic history and the histories of science and thought, an all-embracing definition of enlightenment is rendered difficult.<sup>96</sup> The diversity of thought and conditioning that went into establishment and evolution of enlightenment determines that attempts to define it within strict bounds, would be inappropriate. He suggests that it is more useful to consider enlightenment to be constructed of ‘strands’, some of which are bonded into a central core and other ‘looser threads’ whose significance is open to interpretation.’ This is fine as far as it goes, but it is avoiding the issue of those ‘looser threads,’ which frequently represent enlightened thinking but are not necessarily conditioned by the same drivers as the French *lumiere*.

Munck views Porter and Teich's volume of essays as problematical, attempting, as it does, to define enlightenment from ‘national perspectives or reflecting different cultural and political contexts.’ He claims ‘the formative theorists of Enlightenment espoused a philosophy that was diametrically opposed to ‘parochialism and insularity.’ But a national or regional identity does not necessitate insularity, rather its identification reveals characteristics of diverse manifestation of enlightenment behaviour.<sup>97</sup> John Robertson remains committed to the concept of a single Enlightenment and dismissive of geographical diversity along the lines of ‘national contexts.’ He argues the case of ‘pre-occupation with human betterment in the guise

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<sup>96</sup> Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p. 2.

<sup>97</sup> Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p. 3.

of political economy' which became a Europe-wide obsession in the second half of the eighteenth century, as being a thread that connects enlightenment thinkers.<sup>98</sup>

The Italian historian Franco Venturi defined the existence of Enlightenment largely on the presence of *philosophes* or *gens de lettres* and John Pocock believes that in accepting that presumption, there is little to challenge a rationale or hypothesis that England was excluded from Enlightenment: 'it was just different.'<sup>99</sup> But for Pocock the assumption is flawed. He does not deny the presence and activities of *philosophes* in Paris, or the geographical extent of their influence, but highlights the fact that contemporary intellectual and cultural activity was occasioned in England, and elsewhere, which was progressive, 'mainly Protestant in origin and character' and merits the appellation of 'Enlightenment.' He further argues that Enlightenment 'denotes a complex of phenomena, diverse yet associated in their origins;' which may mean that there were forms in which England was not involved.<sup>100</sup> But in attempting to draw together a picture of Enlightenment as a singularity he proclaims that "there can be no definition which 'rules' or 'dominates' the history of either 'Enlightenment' or 'Europe' in such a way as to leave England exceptional."

#### **2.2.4 'National Context.'**

The essays assembled by Porter and Teich, address not only conventional historiography that denies the presence of an English Enlightenment but the issue of the diversity of manifestations of enlightened thought and activity across the developed world.<sup>101</sup> Porter argues that earlier historiography 'treats Enlightenment as systems of socially disembodied ideas,' with *philosophes* studied either with little regard to their social and political contexts,

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<sup>98</sup> Robertson, J., 'The Enlightenment above national context: political economy in eighteenth-century Scotland and Naples,' *Historical Journal*, 40:3 (1997) pp. 667-97, cited in Jones, P. M. *Industrial Enlightenment: Science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2008), p. 7

<sup>99</sup> Venturi, F., *Utopia and Reform in the Enlightenment* (Cambridge, 1971), cited in Pocock, J. G. A., *Barbarism and Religion, Volume 1, The Enlightenment of Edward Gibbon, 1737-1764* (Cambridge, 1999), pp. 294-5.

<sup>100</sup> Pocock, J. G. A., *Barbarism and Religion Volume 1: The Enlightenment of Edward Gibbon, 1737-1764* (Cambridge, 1999), pp. 294-5.

<sup>101</sup> Porter, R., and Teich, M. (eds.), *The Enlightenment in National Context* (Cambridge, 1981).

or on the basis of being French.<sup>102</sup> He makes claims for the existence of many different forms of Enlightenment and argues that conventional structural formulation is undermined when such variants are examined in the specific contexts in which they occurred.<sup>103</sup> He highlights the approbation English governance, society and opinion received across Europe in the first half of the century in particular. Voltaire, Diderot and others professed admiration for English thinkers: ‘Without the English, reason and philosophy would still be in the most despicable infancy in France.’<sup>104</sup>

Porter's point is that much of the earlier English history of the Enlightenment did not acknowledge the substance and relevance to Enlightenment of English thinking, despite endorsement by many of the continental *philosophes*. He declares that such denial is led by a defining presumption that there existed only a single Enlightenment, and, as its natural home was France, determination of its onset, by default, was the 1740s.<sup>105</sup> He also argues that an attribution of atheism to Enlightenment, naturally limits its focus to France, whereas in Britain, Italy and Austria enlightened ideals were being pursued by believers and clerics. However in those countries, unlike France, prevailing faith-based structures afforded no exclusivity of control over thought and teaching.<sup>106</sup> Precepts established by historians of the Enlightenment militated against the acceptance of an English Enlightenment, a flawed perception in the eyes of Porter and increasingly by others. J. H. Plumb for example asserts that ‘too much attention...is paid to the monopoly of ideas amongst the intellectual giants, too little to their social acceptance. Ideas acquire dynamism when they become social attitudes,

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<sup>102</sup> Porter, R., 'The Enlightenment in England' in Porter, R., and Teich, M. (eds.), *The Enlightenment in National Context* (Cambridge, 1981), p. vii.

<sup>103</sup> Porter, R., 'The Enlightenment in England' in Porter, R., and Teich, M. (eds.), *The Enlightenment in National Context* (Cambridge, 1981), p. vii.

<sup>104</sup> Diderot, D., *Oeuvres complètes*, III, 416 in Gay, *The Enlightenment*, 1, p. 12.

<sup>105</sup> Porter, R., 'The Enlightenment in England' in Porter, R., and Teich, M. (eds.), *The Enlightenment in National Context* (Cambridge, 1981), pp. 3-4.

<sup>106</sup> Porter, R., 'The Enlightenment in England' in Porter, R., and Teich, M. (eds.), *The Enlightenment in National Context* (Cambridge, 1981), p. 7.

and this was happening in England,<sup>107</sup> which has resonance in the light of English economic and social progression. The English economy had adopted consumerism and it progressed through the social ranks. With it went the right of participation in enlightened values, allowing aspiration to become socially acceptable.<sup>108</sup>

The differences between national approaches to Enlightenment may have a deal to do with social structures in Munck's view.<sup>109</sup> He states that the German philosophers favoured metaphysical reflection revealing the degree of state, institutional and religious authority that determined structural organisation. The French on the other hand pursued 'empirical re-evaluation' of values. There was a persistent tendency to 'rhetoric, gesture and superficiality' within French expressions of ideals whilst in Germany, state-sponsorship of change and ideas disseminated by the Protestant Universities, propelled Germany Enlightenment.<sup>110</sup> British influence was pervasive across the continent at times: in the 1730s and 1740s Newton and Locke were admired and later in the century British developments, prosperity and lifestyles were envied and sought.<sup>111</sup> Munck believes that such regionalised disparity makes the establishment of 'a coherent core' more problematic and cites Robertson's view that the pursuit of 'national perspectives' has introduced a distortion, brought about by the artificial extension of national influence in the European context.<sup>112</sup> There is perhaps a degree of irony that the advocates of the French-dominated concept of Enlightenment should frequently diminish thoughts and practices in other locations when, as Robert Darnton proclaims 'the

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<sup>107</sup> Plumb, J. H., 'Reason and unreason in the 18thc: the English experience,' in *In the light of history* (London 1972), p. 24 cited in Porter, R., 'The Enlightenment in England' in Porter, R., and Teich, M. (eds.), *The Enlightenment in National Context* (Cambridge, 1981), p. 7.

<sup>108</sup> Porter, R., 'The Enlightenment in England' in Porter, R., and Teich, M. (eds.), *The Enlightenment in National Context* (Cambridge, 1981), p. 11.

<sup>109</sup> Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p. 6.

<sup>110</sup> Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p. 6.

<sup>111</sup> Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p. 6.

<sup>112</sup> Robertson, J., 'The Enlightenment above national context: political economy in eighteenth-century Scotland and Naples,' *Historical Journal*, 40 (1997), p. 671, cited in Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p. 6.

*philosophes* themselves were no respecters of boundaries, either subject or national. They were ‘open to ideas from everywhere.’<sup>113</sup>

Testimony to the ideals of Enlightenment is locally identifiable and geographical variations in their application are considerable.<sup>114</sup> Mokyr comments that elements of regionally acquired or developed knowledge were disseminated through publication, correspondence and personal contacts and over time some differentials would be diminished.<sup>115</sup> But that does not prevent the shape of Enlightenment in different locations remaining distinct; in the case of Shropshire, not least because of the influential role played in the onset of Industrial Revolution. The desirability of study into the locally-specific manifestations of Enlightenment behaviour persists, to which end this study contributes.

### **2.3 The concept of ‘improvement’**

A ‘culture of improvement’ that has conditioned aspects of human progress is defined by Robert Friedel as, ‘the ascendancy of values and beliefs permeating all levels of society that “things could be done better.”’<sup>116</sup> It was a cultural concept that the eighteenth-century philosopher, Adam Ferguson (1723-1816) acknowledged: man’s desire to improve, to attain an ideal:

If we admit that man is susceptible of improvement and has in himself a principle of progression and a desire for perfection it appears improper to say that he has quitted the state of his nature, when he has begun to proceed; or that he finds a station for which he was not intended.<sup>117</sup>

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<sup>113</sup> Darnton, R., ‘The case for the Enlightenment: George Washington’s false teeth,’ in *George Washington’s false teeth: an unconventional guide to the eighteenth century* (London, 2003), p. 19.

<sup>114</sup> Withers, C. W. J., *Placing the Enlightenment: Thinking geographically about the Age of Reason* (Chicago, 2007), p. 75.

<sup>115</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009), p. 36-7.

<sup>116</sup> Friedel, R., *A culture of improvement: technology and the Western Millennium* (Cambridge, Mass., 2007), p. 2.

<sup>117</sup> Ferguson, A., *Essay on the history of civil society*, (London, 1767), Oz-Salzberger, ed., (Cambridge, 1995), p. 14.

‘Improvement’ as a cultural construct is frequently used synonymously with Enlightenment but examples of its utilisation extend beyond acknowledged chronological bounds of Enlightenment. Asa Briggs comments on ‘improvement’ having a pedigree that reached back to Dr Samuel Johnson (1790-1784) and Daniel Defoe (1659/61-1731), but examples are to be found from the mid-sixteenth-century of its application in the context of management of land.<sup>118</sup> Fitzherbert’s *The Boke of Surueying and Improuments* (1523), deals with the implications and appropriate behaviour concerning enclosure and estate management:

Than the lorde hath improued hym selfe of as much woodes and wastes as he can lawfully and when he hath giuen or sold the resydeieue of that he can not ymproue hymselfe of it. In lyke maner the donee nor the biour can not improue hymselfe of any parte thereof. For they can not be in no better case than he of whom they had it.<sup>119</sup>

By the end of the seventeenth-century ‘improvement’ had migrated within public consciousness from direct association with land management into other areas.<sup>120</sup> The extent of that perception needs further research but the writer, businessman and non-conformist, Daniel Defoe, in theorising upon the efficacy of the schemes and speculations of the late seventeenth-century, drew comparisons between:

New Inventions and Projects, between Improvement of Manufactures or Lands, which tend to the immediate Benefit of the Publick, and Employing of the Poor; and Projects fram'd by subtle Heads, with a sort of a *Deceptio Visus*, and *Legerdemain*, to bring people to run needless and unusual hazards.<sup>121</sup>

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<sup>118</sup> *Oxford English Dictionary*, Online edition, <<http://www.oed.com/view/Entry/92858?p=emailAadhu6Hq/Sq8Q&d=92858>.

<sup>119</sup> Fitzherbert, J., *The Boke of Surueying and Improuments* (London, 1523), p. 14, Early English Books Online, <http://eebo.chadwyck.com.ezproxyd/bham.ac.uk>, Accessed 7 Feb 2013.

<sup>120</sup> Borsay, P., ‘The Culture of Improvement,’ in Langford, P., *The Eighteenth Century: 1688-1815* (Oxford, 2002), p.184.

<sup>121</sup> Defoe, D., *An Essay upon Projects* (Stoke Newington edn, 1999, originally London, 1696), p. 11.

The notion of ‘improvement’ is employed in the sixteenth and seventeenth centuries in a manner which indicates that it was not an Enlightenment construct, however, its adoption into a cultural ethos that fostered industrialisation and awakening social awareness in the eighteenth-century, is illustrated in this chapter. A further consideration arising from the above quote does have resonance with later expressions of Enlightenment ideals incorporating the pursuit of economic advancement. In supporting the principle of encouragement for those engaging in invention and the improvement of land and manufactures, Defoe marked a preference for such activities that contributed to the wider benefit of society, in comparison to those undertaken solely for personal gain. It is a distinction that is sometimes blurred by commentators who define without qualification the pursuit of economic advantage as an Enlightenment concept. Defoe’s position has overtones of the philosopher John Locke (1632-1704), an acknowledged formative influence in the development of Enlightenment and is a subject which will be the focus of further reflection in the next chapter.<sup>122</sup> In terms of the duration of the notion of improvement as a cultural phenomenon, Briggs cites the statistician, G. R. Porter’s declaration in the 1840s that ‘all the elements of improvement are working with incessant and increasing energy.’<sup>123</sup>

By the middle of the eighteenth-century, the pace of change in England was demonstrable and was reflected in the relocation of the focus of philosophical activity from London to the provinces. There existed ‘a growing appetite for understanding and for improvement,’ not just amongst the elite and the educated but within all social groupings.<sup>124</sup> The notion of ‘improvement’ migrated; from being seen as a concept widely associated with agrarian reform to being the visible representation of enlightened ideals, across cultural, civic and economic

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<sup>122</sup>For example Locke, J., *An essay concerning human understanding* (London, 1690); Hampson, N., *The Enlightenment: An evaluation of its assumptions, attitudes and value* (London, 1968); Munck, T., *The Enlightenment: a comparative Social History, 1721-1794* (London, 2000).

<sup>123</sup> Porter, G. R., *Progress of the Nation* (London, 1847) in Briggs, A., *The Age of Improvement* (Folio edition 1997, originally London, 1959), p. 1.

<sup>124</sup> Kirk, L., ‘The Matter of Enlightenment,’ *The Historical Journal*, Vol. 43, No 4(Dec. 2000), p. 1129.

sectors. On a journey from Shropshire to the Potteries, Samuel More (1726-1799) wrote: ‘The spirit of improvement (which Mr Wedgwood so happily began in this neighbourhood) continues to spread itself through all the People and in Consequence of it a new Turnpike Road is now making from Newcastle, thro Woolstanton to Burslem...’<sup>125</sup> But whilst such was the perception of the progress of change that was infecting the whole country, the extent of local variation in timing and sectoral improvement is an important element in understanding that progress. As will be seen in later chapters on regional economic and agricultural innovation, progress was not uniform. It was not uniform in the sense that circumstance, perceived need or the state of prevailing knowledge at a point in time, frequently determined the nature and timing of the onset of change. As More indicates, it was in some instances, a local catalyst. Geographical variations influenced the uptake of agricultural improvements from one part of the country to another and the presence of a local supply of raw materials determined the location of particular industries. Predominantly, the process of change was not a linear progression.<sup>126</sup> Competing influences determined the timing, extent and direction of development. In Shropshire industrial innovation was largely confined to the second half of the eighteenth-century, whereas agricultural improvement, enclosure excepted, did not gather pace until the mid-nineteenth. John Bishton (n.d.-1807) land agent, industrialist and farmer, in one of the early agricultural reports for the Board of Agriculture in 1794, wrote of Shropshire:

The roads, both turnpike and private, are generally bad...the private ones, particularly in the clay part of the county, are about impassable to any but the inhabitants, notwithstanding there have been many acts of parliament, with a view to making them

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<sup>125</sup> Ironbridge Gorge Museum Library, *Transcription of Samuel More's Journal*, July 1776, , p.107 (original journal page 46).

<sup>126</sup> See Hayman's argument concerning lack of linear progression in Shropshire wrought-iron development in Hayman, R , *The Shropshire Wrought-iron industry c1600-1900*, unpublished PhD thesis, University of Birmingham, 2003, p. 215.

perfectly good, which end, if it could be obtained, would be a most important step to improvement in agriculture;<sup>127</sup>

Despite this, infrastructure improvement featured strongly in the region throughout the Enlightenment period. Early-stage developments of canals and rail ways, built in association with industrial activity, were witnessed and landowners and industrialists promoted major canal and railway constructions.<sup>128</sup> Innovations in civil and structural engineering accompanied these projects, as demonstrated on the Ellesmere Canal and its aqueducts.<sup>129</sup> The steam-engine designers, such as Trevithick and Hornblower, who gravitated for a time to Shropshire, were at the forefront of railway development. John Urpeth Rastrick (1780-1856) worked at Ketley ironworks and was a partner of John Hazeldine at Bridgnorth in building engines and agricultural machinery.<sup>130</sup> He later became one of the country's principal railway designers in the second quarter of the nineteenth-century.<sup>131</sup>

Reflections on a prevailing cultural climate of innovation and change are afforded by a speech given by Rowland Hunt Esq. (1753-1811) on 26 November 1805.<sup>132</sup> In his oration at the opening of the Pontcysyllte Aqueduct, the Shropshire landed estate owner characterised the period and its wider setting and recognised the collaborations and the innovative processes that culminated in the events of that day. He placed Pontcysyllte into context in terms not only related to the innovatory aspects of its construction but with classical and continental

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<sup>127</sup> Bishton, J., *A general view of the Agriculture of the County of Salop: with observations on the means of its improvement* (Brentford, 1794), University of Birmingham Special Collections, (Ref: rHD1930.H4)

<sup>128</sup> Trinder, B., *The Industrial Revolution in Shropshire* (3<sup>rd</sup> ed. Chichester, 2000.), pp. 62-73; Transcription of Samuel More's Journal, 15 July 1776' Ironbridge Gorge Museum Library, p. 4(original journal p. 16); Mott, R. A., *Tramroads of the eighteenth century and their originator, John Curr*, Transactions of the Newcomen Society, Vol. XL II (1969-70), pp. 1-18; Richards, E., *The Leviathan of Wealth* (London, 1973), p. 46-78; Staffordshire Record Office, Ref: D593/K/1/5/21, *Sutherland Collection, Chief agent's OUT letters, 1825*, James Loch to Josiah Jessop, 5th Jan 1825,.

<sup>129</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), pp. 150-196; Hadfield, C., *Thomas Telford's Temptation: Telford and William Jessop's Reputation* (Shropshire, 1993); Hadfield, C. And Skempton, A. W., *William Jessop, Engineer*, (Newton Abbot, 1979), pp. 139-153.

<sup>130</sup> Peacock, R., (ed.), *James Foster of Stourbridge, 1786-1853: Industrialist and benefactor* (Kingswinford, 2006), p. 23-4.

<sup>131</sup> Peacock, R., (ed.), *James Foster of Stourbridge, 1786-1853: Industrialist and benefactor* (Kingswinford, 2006), p. 23-31; Boase, G. C., 'Rastrick, John Urpeth (1780-1856)', rev. M. W. Kirby, *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edn, Jan 2008 [<http://www.oxforddnb.com/view/article/23153>, accessed 4 Oct 2012].

<sup>132</sup> Hunt, R. 'Report to the General assembly of the Ellesmere Canal Proprietors held at the Royal Oak Inn, Ellesmere on 27<sup>th</sup> day of November 1805 to which is annexed, The Oration, delivered at Pontcysyllte Aqueduct on its first opening, November 26 1805', Ironbridge Gorge Museum Library.

references. He also called attention to those who had imagination to set the process in train for the commercial improvement of the Kingdom. Telford and Jessop who designed and supervised construction of the canal and its aqueducts are lauded but interestingly Hunt also called for approbation for other members of the construction team. In doing so he highlighted the importance of such ‘intellectual communities’ in the progress of acquisition, generation and dissemination of knowledge. Individuals were contributing to solutions of problems and taking the knowledge acquired into other projects and spheres.<sup>133</sup> The principals, Telford and Jessop, go on to enhance their reputations as civil engineers with other major enterprises and William Hazeldine, John Simpson and Matthew Davidson, in particular, established themselves with notable success in their respective fields.<sup>134</sup> Hunt made several references to the concept of improvement and of striving for betterment in all facets of life. In the context of developed or prevailing cultural tenets it would undoubtedly have found resonance in the audience. The spirit of social obligation emerges in Hunt’s oration with the call to recognise and serve the needs of others as well as the pursuit of profit. Identifiable expressions of social concern are represented in the diverse notions of improvement in Shropshire to the point where considerations of enlightened reaction and improvement are almost synonymous.<sup>135</sup>

Katherine Plymley (1758-1829), the diarist, naturalist and painter, recorded in her journal the involvement of her family and their friends in the 1791 campaign for the abolition of the slave trade.<sup>136</sup> In 1808 she notes the formation of an African Society in Shrewsbury. Amongst its aims were, ‘to endeavour to enlighten the minds of the Africans...to introduce amongst them such of the improvements and useful arts of Europe as are suited to their condition.’<sup>137</sup> She frequently recorded the role of her brother, Archdeacon Joseph Plymley (Corbett) (1759-

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<sup>133</sup> The case study on Pontcysyllte develops this theme.

<sup>134</sup> See Chapter 3- Case study- Pontcysyllte Aqueduct.

<sup>135</sup> Borsay, P., ‘The Culture of Improvement,’ in Langford, P., *The Eighteenth Century: 1688-1815* (Oxford, 2002), p.184.

<sup>136</sup> The issue of social concern in contemporary Shropshire for the welfare of others is explored more fully in Chapter 6.

<sup>137</sup> Shropshire Archives, Ref:1066/73, *Corbett of Longnor Collection, Katherine Plymley Journals, Oct 28th 1807 to Jan 31st 1808, 31st Jan 1808.*

1838), for a time a focus of local efforts for social amelioration.<sup>138</sup> In the mid-1790s he was actively pursuing improvements in the turnpiking of roads; he was a director of Shrewsbury Infirmary; he engaged in the preparation of a report on Shropshire agriculture for the Board of Agriculture; he became a magistrate for Condover Hundred and was appointed to a committee of trustees to redress problems at Shrewsbury School.<sup>139</sup>

In an address in 1825 on behalf of the London Mechanics' Institute, the reforming politician, Henry Brougham (1778-1868), wrote '...although the people must be the source and instruments of their own improvements, they may be essentially aided in their efforts to instruct themselves...'.<sup>140</sup> In that same year the Shrewsbury Mechanics Institution was established with the aid of members of the Shropshire elite, including local Members of Parliament, the industrialist John Marshall (1765-1845) and barrister Richard Aglionby Slaney (1792-1862).<sup>141</sup>

In the industrial sector, examples of innovation, improvement and invention are plentiful.<sup>142</sup> An apparent change in the dynamic of improvement as the nineteenth-century progressed is also acknowledged. The principal contributions to change locally, originated with the ironmasters. John Wilkinson (1728-1808), sought improvements in manufacturing processes and in business opportunities.<sup>143</sup> William Reynolds (1758-1803) attracted many engineers and canal builders to his Shropshire ironworks, in pursuit of knowledge of the attributes of iron and to engage in experimentation on engines. Abraham Darby III (1750-1789) established a reputation as an innovative industrialist and his legacy is one of the most enduring images of

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<sup>138</sup> Shropshire Archives, Ref:1066/73, *Corbett of Longnor Collection, Katherine Plymley Journals*.

<sup>139</sup> Grounds, D. *Son and servant of Shropshire: the life of Archdeacon Joseph(Pylmley) Corbett, 1759-1838* ( Herefordshire, 2009), p. 96.

<sup>140</sup> Brougham, H., *Practical observations upon the education of the people addressed to working classes and their employers* (London, 1825), p. 2, University of Birmingham Cadbury Library.

<sup>141</sup> University of Birmingham, Cadbury Library, Ref: 6001/120, 'Journals of R. A. Slaney, 1815-50, 16 November 1825,' Ref: RAS/1/1-5; Shropshire Archives, *Minutes of the proceedings of the Shrewsbury Mechanics Institution*..

<sup>142</sup> Industrial innovation is explored at length in Chapter 4- 'Industrial dimension of intellectual activity.'

<sup>143</sup> Randall, J., *Our coal and iron industries and the men who have wrought in connection with them. The Wilkinsons; with portrait of John Wilkinson, "The father of the iron trade," and descriptions of the first iron vessel and the first iron bridge.*(Madeley, 1876, reprint 1917), p. 22.

the Industrial Revolution: the Iron Bridge. Amongst artisans the mobility of workers, instruction in new techniques and the experience gained empirically through the application of acquired skills led to incremental increases in knowledge that were frequently as important as landmark innovations in advancing the cause of industrial development.<sup>144</sup> Richard Hayman's study of the Shropshire wrought-iron industry persuades him of the importance of artisanal contributions to local industrial improvement.<sup>145</sup> In a different sphere of industrial activity, the Manchester cotton-spinner John Kennedy (1769-1855) recalled in his memoirs that at the age of fourteen he and another apprentice shared the cost of five shillings for a series of John Banks' lectures in Lancashire that they attended alternately. He records that it 'offered a wondrous insight into the laws of nature.'<sup>146</sup> Having established a successful cotton manufacturing business in Manchester, he and his partner, James M'Connell, became prominent members of the Literary and Philosophical Society and Kennedy a judge at the Rainhill railway trials in 1829.<sup>147</sup> Such was the prospect for the ambitious artisan.

The activities of the Spitalfields Mathematical Society in East London reflected the interest of many artisans in natural philosophy and self-improvement and were dedicated to the cause of public education. Its determination to make philosophy accessible to those excluded by cost constraints and opportunities to advance themselves, led to a reduction of entrance fees to six pence per lecture and the consequent attendance by hundreds of people.<sup>148</sup> By way of further indirect evidence of the involvement of artisans in the processes of useful-knowledge assimilation, in *Concise Essays*, the itinerant lecturer, John Warltire (n.d.-1810) explains that his essays are targeted 'at artisans and natural philosophers in the hope that notes and

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<sup>144</sup> Berg, M., 'The genesis of useful knowledge', *History of science*, xlv, 2007, pp. 123-133, p. 129; Hilaire-Perez, L., 'Technology as a public culture in the eighteenth century: the artisans legacy,' in *History of science*, 45, 2007, pp135-153, p. 137.

<sup>145</sup> Hayman, R., *The Shropshire Wrought-iron industry c1600-1900*, PhD thesis, University of Birmingham, 2003, pp. 148-9.

<sup>146</sup> Kennedy, J., *Miscellaneous Papers* (Manchester, 1849), p.14, cited in Musson, A.E., and Robinson, E., *Science and technology in the industrial revolution*, (Manchester, 1969), p.108.

<sup>147</sup> Jacob, M. C., 'Mechanical science on the factory floor: the early industrial revolution in Leeds,' in *History of Science*, xlv, 2 (June 2007), p. 211; C. H. Lee, 'Kennedy, John (1769-1855)', *Oxford Dictionary of National Biography*, Oxford, 2004, <http://www.oxforddnb.com/view/article/15385>, accessed 6 Feb 2013.

<sup>148</sup> Stewart, L., 'Experimental spaces and knowledge economy,' *History of science*, xlv (2007), pp. 155-173.

accompanying experiments and courses will lead to improvements in the application of those branches of chemistry.’<sup>149</sup> Some artisans undoubtedly took the opportunity to improve themselves to the point of contributing to technical knowledge, but its incidence is likely to be governed by local variability of trade skills. Birmingham and Sheffield had economies based predominantly upon small workshops and high skill-sets compared to mine, foundry or mill hands and the possibility remains that the pursuit of improvement amongst artisans in Shropshire may have been at a lower level than in the major engineering towns.

The extent of agricultural improvements in much of Shropshire in the eighteenth-century was largely restricted to reclamation of waste land. In select areas, however, such as some eastern parts of the county where soil characteristics were favourable, examples of Norfolk-style four-course crop rotation were employed. In his 1803 report on the state of agriculture in Shropshire, Joseph Plymley made a strong argument for the enclosure and improvement of remaining commons and wastes, painting a picture of the ‘miserable huts, and poor, ill-cultivated, impoverished spots erected, or thrown together, and enclosed by themselves.’<sup>150</sup> Fundamental changes in land tenure, effected in the latter part of the century and early part of the nineteenth, were a necessary pre-condition to improvement, as they frequently incorporated the consolidation of farms into larger units and greater landlord investment in infrastructure.<sup>151</sup> From the turn of the century the pace of improvement was spasmodic until the period of ‘high-farming’ between the 1840s and 1860s. The social imperative associated with being viewed as an improving farmer/landlord was important for socially conscious estate owners in Shropshire and in some instances, William Childe of Kinlet for example, the financial implications of the pursuit of improvement left the estate heavily encumbered with

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<sup>149</sup> Warltire, J., *Concise essays upon various philosophical and chemical subjects proper to be read before or after Courses of Chemistry, or experimental philosophy*, (London, 1773).

<sup>150</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture and Internal Improvement* (London, 1803), p. 224.

<sup>151</sup> Baugh, G.C. (ed.), *A history of the county of Shropshire: vol. 4: Agriculture* (London, 1989), p. 168.

debt. Dr Robert Darwin of Shrewsbury held a mortgage to the tune of £20,000 on the Childe estates in 1820.<sup>152</sup> Apart from capital expenditure, the development and dissemination of knowledge played an important role in the application of new farming techniques; the development of improved equipment, crops and breeds, and the establishment of appropriate means of knowledge transfer. Publications on farming; the establishment of agricultural societies and shows creating incentives to present improved breeds and crops and exchange knowledge; and the activities of the Board of Agriculture all promoted improved farming practice.<sup>153</sup> The emulation of others: friends, neighbours or exemplars, furthered the cause of improvement and change was stimulated by increased enthusiasm for the study of agrarianism.<sup>154</sup> Whether individual improvers or agricultural societies advanced scientific knowledge is not in itself a defining issue for their effectiveness in the momentum for improvement.<sup>155</sup> That was much to do with the perception that they were involved in that process.

## 2.4 Conclusion

Such illustrations reveal Enlightenment references and the cultural notion of improvement well into the nineteenth century. Declarations of improvement in contemporary narratives do not resolve the difficulty in identifying improvement (or Enlightenment expressions) any better than a rigid adherence to periodisation: they do not necessarily convey an intent to improve for the 'benefit of the greater good.' Enlightenment and improvement are treated as distinct concepts and Borsay considers that by the end of the eighteenth-century the latter formed the central element of British Enlightenment.<sup>156</sup> In such a scenario they would have

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<sup>152</sup> Shropshire Archives, Ref: 1045/908, *Mortgage and release between Robert Darwin and William Child, 20 April 1820.*

<sup>153</sup> Chapter 4 explores agricultural improvement in Shropshire in greater depth.

<sup>154</sup> Brown, D. G., *Enclosure and Improvement: an investigation into the motives for Parliamentary enclosure*, Unpublished PhD thesis, Wolverhampton Polytechnic, 1992, p. 374.

<sup>155</sup> Wilmot, S., *The business of improvement: Agriculture, and scientific culture in Britain, c1700-c1870* (Bristol, 1990), p. 37.

<sup>156</sup> Borsay, P., 'The culture of improvement,' in Langford (ed.), *The Eighteenth Century* (Oxford, 2002), p. 184.

functioned for a period of time as a parallel culture. A more coherent rationale is that the process known as Enlightenment was the combination of factors in England that invigorated the pre-existing cultural concept of improvement.

The presence of innovation, technological or social enhancements does not, of itself, determine contemporary conformity with Enlightenment tenets. The enthusiasm for knowledge and the betterment of aspects of society captured both the spirit of improvement and, on occasions, the ideals of Enlightenment. The descriptive use of the word 'improvement' is not the issue; it is the underlying ethos that it portrays in the historical narrative. That the will sometimes exists in the individual to achieve something better, whether for the greater good or not, establishes the presence of a cultural concept. For Robert Friedel, 'the real significance of the culture of improvement lies in its role in the lives of the men and women who are actually making and doing things,' as are presented in the following substantive chapters.<sup>157</sup>

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<sup>157</sup> Friedel, R., *A culture of improvement: technology and the Western Millennium* (Cambridge, Mass., 2007), p. 7

## Chapter 3: The Pursuit of Improvement: Infrastructure Development in Shropshire, 1750-1840

### 3.1 Introduction

Improvement is dependent upon the existence of appropriate conditions for change. In Shropshire, from the middle of the eighteenth-century, enhancement of infrastructure, particularly in the area of transport and communications, provided a platform on which industrial advances could be laid. Canals and early-stage rail- or plate-ways provided the means of manipulation and shipment of the large quantities of material overland that became vital in the onset of industrialisation. The development of these service networks, however, relied heavily on the skills and innovation of individuals who were located in the area or came to Shropshire with the specific aims of acquiring or imparting knowledge. John Curr (n.d.-1823), for example, who had developed a form of rail road in Sheffield was invited to advise The Coalbrookdale Company on the installation of a plateway.<sup>158</sup>

For a short period of time, the area acted as a nodal point for knowledge exchange. Visitors were drawn to view the Iron Bridge and the ferment of industrialisation, which formed a part of a regional setting of attractions of which Boulton's Soho Manufactory was an element.<sup>159</sup> For industrialists and engineers it was a location of innovation and dynamic activity and provided the opportunity for the association of like minds. In this chapter, examples of improvements in local infrastructure are identified together with the means for their accomplishment. The study focuses upon the extent to which they were reliant upon intellectual developments. It considers whether such improvement was conditioned by

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<sup>158</sup> Transcription of part of a letter dated 25th May 1793, sent by John Curr to the Coalbrookdale Co in Bland, F., 'John Curr, Originator of Iron Tramroads', *Transactions of the Newcomen Society*, vol 11 (1930-31) pp. 120-29.

<sup>159</sup> Jones, P. M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009), pp. 94-109.

enlightenment ideals other than economic advancement and how enlightenment and the notion of improvement were represented. The chapter highlights examples of the dissemination of knowledge and demonstrates the importance of shared knowledge in the improvement of transport infrastructure. The construction of the Ellesmere Canal and Pontcysyllte Aqueduct is utilised as a case-study to draw-out details of such enlightened activity.

### 3.2 The Shropshire rail ways

Rail ways were functioning in Shropshire from the early seventeenth-century as a means of carrying coal from the mines to the Severn and were likely to have run on wooden wheels and rails.<sup>160</sup> By the middle of the eighteenth-century, with the expansion of iron production, the ‘rail roads’ were carrying iron-ore, limestone and coal to the furnaces, in addition to distribution of the finished product.<sup>161</sup> Trinder suggests that the construction in 1749 of a line conveying raw materials into Coalbrookdale was the first instance of an ironworks being supplied this way.<sup>162</sup> He notes the substantial investment in rail transport made by the Coalbrookdale Company during the 1750s and 1760s.<sup>163</sup> Rails made of a double layer of wood had been adopted, the top layer being capable of replacement ‘without disturbing the whole track bed.’ This arrangement was revised in 1767 by Richard Reynolds, the manager at Coalbrookdale, who substituted iron for the upper section of rail and is held to represent the first use of an iron rail. The description by Samuel More in 1776, of a rail road running from Wilkinson’s limestone quarry near Broseley, is of ‘Bars of Cast Iron,...which are fastned (sic) by Wooden Pins to Wooden Sleepers laid across the Horse Tract, and the Carriages running

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<sup>160</sup> Trinder, B., *The Industrial Revolution in Shropshire* (3<sup>rd</sup> ed. Chichester, 2000.), pp. 11-13; ‘Recent research on early Shropshire railways,’ in Lewis, M. J. T., ed., *Early Railways 2* (London, 2003).

<sup>161</sup> Ironbridge Gorge Museum Library, *Transcription of Samuel More’s Journal, 15 July 1776’ p. 4*(original journal p. 16); Labouchere, R., *Abiah Darby, 1716-1793, of Coalbrookdale, Wife of Abraham Darby II*, (York, 1988), p. 76.

<sup>162</sup> Trinder, B., *The Darbys of Coalbrookdale*, Phillimore (London, 1981), p 29.

<sup>163</sup> Trinder, B., *The Industrial Revolution in Shropshire* (3<sup>rd</sup> ed. Chichester, 2000.), p. 62; Mott, R. A., *Tramroads of the eighteenth century and their originator, John Curr*, Transactions of the Newcomen Society, Vol. XL II (1969-70), p. 18; Rathbone, H. M., *letters of Richard Reynolds and a memoir of his life* (London, 1852).

on wheels which have Shoulders to prevent their rising over the Rail.<sup>164</sup> He mentions that earlier rail roads had wooden rails, some of which still remained, but that the high cost of maintenance made iron preferable. By 1774 more than seventeen thousand iron rails had been produced by the Coalbrookdale Company and the rail road had become an integral part of the productive process.<sup>165</sup> However its layout differs from that of Wilkinson. Trinder suggests that supporting sleepers for the Coalbrookdale rails would be orientated longitudinally in order to avoid rails fracturing, whereas More refers to the ‘cross-sleepers’ employed by Wilkinson.<sup>166</sup> More’s account also infers that a solid iron rail was used as opposed to the iron-capped wooden rail of Coalbrookdale of the 1760s and 1770s.<sup>167</sup> The Italian natural philosopher Alessandro Volta visited Shropshire in 1782 and saw the rail road laid between Ketley and Coalbrookdale:

The road is covered with two rails or iron bars on which the wheels of the carriages revolve, the wheels having a border that keeps and guides them along the rails. There is not just one such road, but many leading to different parts, two, three or more miles away, the road being in several places double so that two carriages can pass. Rails are fixed on earth by means of wood beams, on which they are nailed down. Can you imagine a more lavish profusion of iron? Yet, such an expenditure is compensated for by the gain in easing transport of coal and minerals. This alone gives you an idea of how big the enterprise is, and of the amount of iron being melted in the furnaces.<sup>168</sup>

Variations existed in the form of rail road used within the county, in terms of track gauge, form and composition and no doubt for a range of reasons. The stage of development of a particular operator may have been significant. Changes in rail road technology were fairly slow to materialise and for established business concerns the status quo was no doubt maintained on the basis of ‘fitness for purpose:’ the judgement based on the degree of

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<sup>164</sup> Ironbridge Gorge Museum Library, *Transcription of Samuel More’s Journal, 15 July 1776*, p. 4(original journal p. 16)

<sup>165</sup> Raistrick, A., *Dynasty of ironfounders* (London, 1953), p. 180.

<sup>166</sup> Trinder, B., *The Industrial Revolution in Shropshire* (3<sup>rd</sup> ed. Chichester, 2000.), p. 62.

<sup>167</sup> van Laun, J., *Early Limestone Railways* (London, 2001) offers a synthesis of early railway development.

<sup>168</sup> Volta papers at the Istituto Lombardo, Accademia di Scienze e Lettere, Milan), L, 3, published in VO (Volta, Alessandro, *Le opere*, 7 vols), 3:165-67), cited in Pancaldi, G., *Volta: Science and culture in the age of Enlightenment* (Princeton, 2003), p. 162.

enhancement in performance or financial benefit accruing from change. More described the existence of an inclined plane on the rail road carrying limestone for John Wilkinson.<sup>169</sup> It was utilised to lower loaded wagons down a steep slope. A fully-laden 'carriage' at the top of the slope was connected to an empty one at the bottom by means of a chain taken around a roller. The descent of the full 'carriage' raised the other to the top of the slope, where, in its turn it could be filled. This was a process that anticipated the canal-inclined planes later introduced by the ironmaster, William Reynolds.<sup>170</sup> Improvement in the form of transport infrastructure in Shropshire was therefore laid on the foundations of a tradition of industrial railways: the next notable innovation was adopted from Sheffield.<sup>171</sup>

John Curr developed a system of angular rails and wagons, or 'corves,' for use underground in the Sheffield Colliery in around 1775/6.<sup>172</sup> The major innovation in the design lay with the incorporation of the flange, for keeping the carriage on the track, onto the rail and not on the wheels of the wagon. Theoretically this allowed the wagon to be utilised on various surfaces as it had 'flat tyres.' By 1788 the system was being used above ground and over the following twenty-five years this 'plateway' represented a significant improvement in materials handling.<sup>173</sup> The most extensive period of building of plateways occurred during the Napoleonic Wars but even after the development of locomotive-hauled railways, the plateway system continued to be used in quarries throughout the country. In a letter in 1822 to Viscount Newport, the Bradford Estate's agent Peter Potter argued the case for the construction of a railway at Llanymynech, Shropshire for transportation of limestone from the mine to the

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<sup>169</sup> Ironbridge Gorge Museum Library, Transcription of Samuel More's Journal, 15 July 1776,' p. 4(original journal p. 18); also see Trinder, B., *The Industrial Revolution in Shropshire* (3<sup>rd</sup> ed. Chichester, 2000.), p. 62.

<sup>170</sup> See later in this chapter- p.60.

<sup>171</sup> Mott, R. A., 'Tramroads of the eighteenth century and their originator, John Curr,' *Transactions of the Newcomen Society*, Vol. XL II (1969-70), p. 1.

<sup>172</sup> Lee, C. H., 'Introduction,' Curr, J., *The Coal Viewer and Engine Builder's Practical Companion* (Sheffield, 1797, 2nd ed. 1970), p. 2.

<sup>173</sup> Mott, R. A., 'Tramroads of the eighteenth century and their originator, John Curr,' *Transactions of the Newcomen Society*, Vol. XL II (1969-70), p. 1.

Ellesmere canal.<sup>174</sup> The Derbyshire-based civil engineers William Jessop and Benjamin Outram both used plateways to link industrial works to their canals and were very much part of the intellectual community that encompassed the Shropshire ironmasters and engineers.<sup>175</sup> Outram himself gave credit to Curr as the designer of the flanged-plate rails that he had utilised and not William Jessop as some have speculated.<sup>176</sup>

In 1793 Curr was invited to Coalbrookdale to offer advice on the Brierley Hill terminus of the Shropshire Canal which utilised a system of tunnels and shafts for the movement of materials.<sup>177</sup> He made recommendations for improvement involving the re-positioning of cranes and the layout of the rail road track and his letter to the company following an initial visit confirms William Reynolds' part in the decision process.<sup>178</sup> Reynolds' contribution to intellectual communities and improvement in the final quarter of the eighteenth-century is highlighted throughout this thesis. Although the Brierley Hill terminus did not long continue in full operation, even after Curr's suggested alterations, it is likely that the introduction of Curr set the seal on the further development of the land-based movement of material. The greater flexibility and cost benefit of plateways clearly led to the extension of railway networks across the Shropshire coalfield, as underlined in Plymley's survey in 1803.<sup>179</sup>

In terms of dissemination of knowledge, Reynolds' invitation to Curr in 1793 was a significant action. The early phase of rail road development was characterised by variation in designs and what appear to be periodic advances, constrained by the scope of contemporary

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<sup>174</sup> Staffordshire Record Office, Ref: D1287/13/8/K/264, *Bradford Collection, Letter from Peter Potter to the Right Honourable Lord Viscount Newport, Castle Bromwich, 21 May 1822.*

<sup>175</sup> Mott, R. A., Tramroads of the eighteenth century and their originator, John Curr, '*Transactions of the Newcomen Society*,' Vol. XL II (1969-70), p. 10.

<sup>176</sup> Lee, C. H., 'Introduction,' Curr, J., *The Coal Viewer and Engine Builder's Practical Companion* (Sheffield, 1797, 2nd ed. 1970), p. 3; Mott, R. A., Tramroads of the eighteenth century and their originator, John Curr, '*Transactions of the Newcomen Society*,' Vol. XL II (1969-70), p. 15..

<sup>177</sup> Trinder, B., *The Industrial Revolution in Shropshire* (3<sup>rd</sup> ed. Chichester, 2000), p. 70; Transcription of letter by John Curr to The Coalbrookdale Company, 25 May 1793 in Bland, F., 'John Curr, Originator of Iron Tramroads', *Transactions of the Newcomen Society*, vol 11 (1930-31) pp. 120-29.

<sup>178</sup> Transcription of letter by John Curr to The Coalbrookdale Company, 25 May 1793 in Bland, F., 'John Curr, Originator of Iron Tramroads', *Transactions of the Newcomen Society*, vol 11 (1930-31) pp. 120-29.

<sup>179</sup> Plymley, J., *A General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1803), p. 312.

technical knowledge. The context of change was parochial, frequently involving individual works. Reynolds had introduced design-enhancement to the coalfield transportation system that was to be utilised for one hundred and fifty years.<sup>180</sup> It reflects the promotion of ideas that accrued from the association of people with a progressive outlook towards technical development and is mirrored in the construction of canals and industrial development. In 1797 Curr published a practical guide for the construction of equipment and machines associated with mining operations, including drawings and tables of dimensions, power output, weights of components and costs of construction (see Image 3/1).<sup>181</sup> It represents an example of the dissemination of practical knowledge in print form and its increasing accessibility to those with the will to avail themselves of it.

The activities of engineers working in Shropshire upon technical innovation and industrialisation, is dealt with in the following chapter but they were influential in furtherance of motive power and transportation. Richard Trevithick the Cornish engineer spent time at Coalbrookdale and Bridgnorth experimenting on high-pressure engines and both companies produced engines and components for him. There is testimony of work on powered vehicles being undertaken. Trevithick wrote: ‘the Dale Co have begun a carriage at their own cost for the realroads (sic) and is forcing it with all expedition.’<sup>182</sup> The company was also making high-pressure boilers by the end of the century.<sup>183</sup> Reynolds apparently had interests in the idea of steam locomotion and upon which he had conducted experiments. He was reported as having built a working locomotive complete with wagon sometime before 1787, a situation his nephew supposedly confirmed.<sup>184</sup> The nineteenth-century historian John Randall claimed to have access to papers and drawings of Reynolds that verified his work on the subject. Other

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<sup>180</sup> Trinder, B., *The Industrial Revolution in Shropshire* (3<sup>rd</sup> ed. Chichester, 2000), p. 63.

<sup>181</sup> Curr, J., *The Coal Viewer and Engine Builder's Practical Companion* (Sheffield, 1797, 2nd ed. 1970).

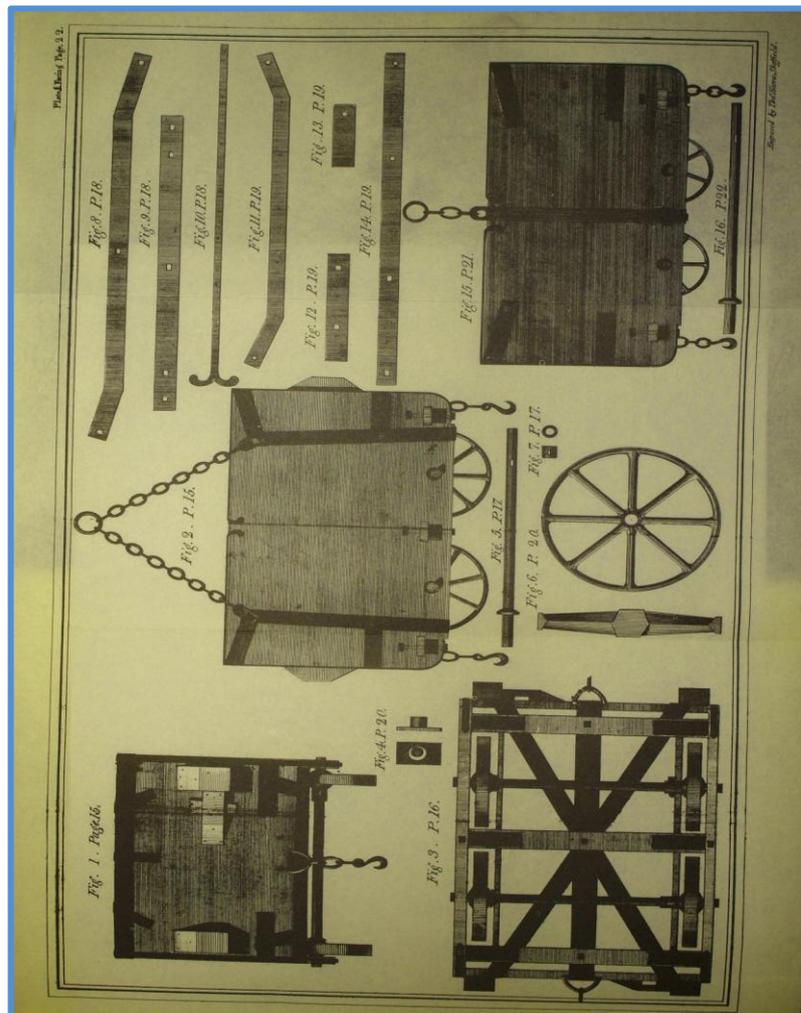
<sup>182</sup> Richard Trevithick to Gilbert Giddy 22 Aug 1802, cited in Raistrick, A., *Dynasty of ironfounders: the Darbys and Coalbrookdale* (London, 1953), p. 162..

<sup>183</sup> Raistrick, A., *Dynasty of ironfounders: the Darbys and Coalbrookdale* (London, 1953), p. 159

<sup>184</sup> Raistrick, A., *Dynasty of ironfounders: the Darbys and Coalbrookdale* (London, 1953), p. 159; Randall, J., *History of Madeley* (1880).

than a sketch book which currently resides in the Science Museum, Kensington, these have since been lost.

Image: 3/1



Plans for construction of 'corves' in Curr, J., *The Coal Viewer and Engine Builder's Practical Companion*, (Sheffield, 1797, 2nd ed. 1970),

John Urpeth Rastrick (1780-1856) worked at Ketley and at John Hazeldine's in Bridgnorth, frequently with Trevithick and upon high-pressure vessels. In 1819 he joined in partnership with James Foster at Stourbridge and continued work on engines and structural engineering and it was this experience and acquired knowledge of the developing field of locomotion that

led to his appointment as one of three judges to the 1829 Rainhill Railway Trials.<sup>185</sup> Rastrick became a leading railway designer and engineer but having been party to a period of great innovation at the high-point of Shropshire technological activity, his later career had no direct association with the county.

The advancement of knowledge associated with infrastructure development was also promoted amongst those who were not engineers or artisans. James Loch (1780-1855) is best known as agent to the 2<sup>nd</sup> Marquis of Stafford who set about reorganising the management of the estates and instituted a programme of agricultural improvement.<sup>186</sup> He was a great advocate of the enhancement of transport systems, recognising the benefits to be gained economically and socially from their introduction.<sup>187</sup> In 1813 and 1816 he promoted the use of rail roads in Shropshire to form a link with disconnected canals, in the belief it would improve the flow of goods from Shropshire and the west midlands to the wider market.<sup>188</sup> He envisaged resulting increases in traffic on the canals, with consequential assistance to depressed industries in the region. Loch acquired an extensive technical knowledge in civil engineering and was later to take a part in the supervision of canal and railway projects. He told his friend Henry Brougham (1778-1868), 'I have always been a great road Engineer,' a skill that he employed on estates for which he had responsibility.<sup>189</sup>

His interest in locomotion was stimulated in the 1820s by the potential threat they posed to the revenues of the canals, in which the Marquis (from 1833 Duke of Sutherland) had substantial financial interests. Loch determined to establish an understanding of issues associated with the construction and running of a railway and he discussed and corresponded

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<sup>185</sup> Peacock, R., (ed.), *James Foster of Stourbridge, 1786-1853: Industrialist and benefactor* (Kingswinford, 2006), p. 23-31; G. C. Boase, 'Rastrick, John Urpeth (1780-1856)', rev. M. W. Kirby, *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edn, Jan 2008 [<http://www.oxforddnb.com/view/article/23153>]

<sup>186</sup> See Chapter 4- 'Agricultural Improvement.'

<sup>187</sup> Richards, E., *The Leviathan of Wealth* (London, 1973), p. 46; the journal article by James Bowen in *Midland History* (2010) is the most recent publication on James Loch, but does not offer greater insight into the subject matter of this thesis.

<sup>188</sup> Richards, E., *The Leviathan of Wealth* (London, 1973), p. 46.

<sup>189</sup> Richards, E., *The Leviathan of Wealth* (London, 1973), p. 46.

with those who could add to his knowledge of the subject: 'it is my duty if I can to endeavour to make up my mind upon the subject by understanding the real merits of the question...'<sup>190</sup> In Loch's case a sense of duty was married to what was appropriate and when elected as a member of Parliament it was as a Whig. He was equally forthcoming in imparting his opinions and knowledge. He travelled to examine the Stockton and Darlington Railway in October 1826 and wrote a lengthy critique of what he discovered, including flaws in the construction and the comparative charges levied for horse-drawn and locomotive-powered journeys.<sup>191</sup> Loch utilised connections afforded by the Leveson-Gower family to ascertain the practical issues encountered during the construction of Lord Carlisle's railway and he formed opinions of the skills, merits and preferences of the individual railway engineers; such as in the utilisation of cast or wrought-iron for rails.<sup>192</sup> With the inevitability of their further development and expansion, Lord Stafford invested in railways and by 1826 was the largest investor in both canals and railways, by value, in Britain.<sup>193</sup> In order to protect those investments, Loch was appointed a director of the Liverpool and Manchester Railway and the Birmingham and Liverpool Canal.<sup>194</sup> Loch pursued the cause of improvement in a number of spheres, including agriculture and recognised the benefit of acquiring useful knowledge and of its dissemination. Although not an engineer, he was able to influence the direction and progress of improvements in infrastructure from positions of social and corporate authority. Loch's influence was not constrained by artificial boundaries of geography and subject and the thematic structure of this study tends to obscure the integrated nature of pursuits engaged

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<sup>190</sup> Staffordshire Record Office, Ref: D593/K/1/5/21, *Sutherland Collection, Chief agent's OUT letters, 1825, Letter James Loch to Josiah Jessop, 5th Jan 1825.*

<sup>191</sup> Staffordshire Record Office, Ref: D593/K/1/5/21, *Sutherland Collection, Chief agent's OUT letters, 1825, Letter James Loch to Capt Bradshaw, 12th Oct 1826.*

<sup>192</sup> Staffordshire Record Office, Ref: D593/K/1/5/22, *Sutherland Collection- chief agent's OUT letters, 1826, Letters Loch to J. Bradshaw- 29th June 1826 and Loch to H. Booth, Liverpool- 7th July 1826.*

<sup>193</sup> Richards, E., *The Leviathan of Wealth* (London, 1973), p. 39.

<sup>194</sup> Eric Richards, 'Loch, James (1780-1855)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [<http://www.oxforddnb.com/view/article/16883>, accessed 15 June 2011].

in by men like Loch and William Reynolds.<sup>195</sup> Where appropriate, however, the substance of enlightened or improving activity is drawn out but it gives evidence of the permeability of boundaries where the flow of knowledge is concerned.

For a short time the Shropshire ironworks had been a nodal point in the generation of knowledge associated with locomotive power but, unlike the early-stage rail roads, which were incorporated into the industrial process, its development had little discernible impact upon local infrastructure. Engineers working locally contributed valuable knowledge during the developmental stage of steam-locomotives; Loch was active in assembling and disseminating knowledge on railways in many parts of the country but by the second decade of the nineteenth-century the centres of railway advancement were dispersed and Shropshire had no part in it.

### **3.3 The East Shropshire Canal System** (see Image 3/2)

Canal enterprises in comparison offer the opportunity to examine infrastructure improvement on a case-by case basis in the light of extant archival material and surviving physical remains. The journals of the visits of Samuel More to the region represent contemporary perspectives of innovation and developments and as Secretary of the Society of Arts he was well-placed to comment on matters of note:

Navigable Canals are making through many Parts of this Country and one of them passes through Mr Wilkinson's Works at Bradley and is of very great Service to Him, for as he not only smelts Iron there, but makes both Bricks and Tiles for Sale he is enabled to send them and his Coals to wherever they are wanted.<sup>196</sup>

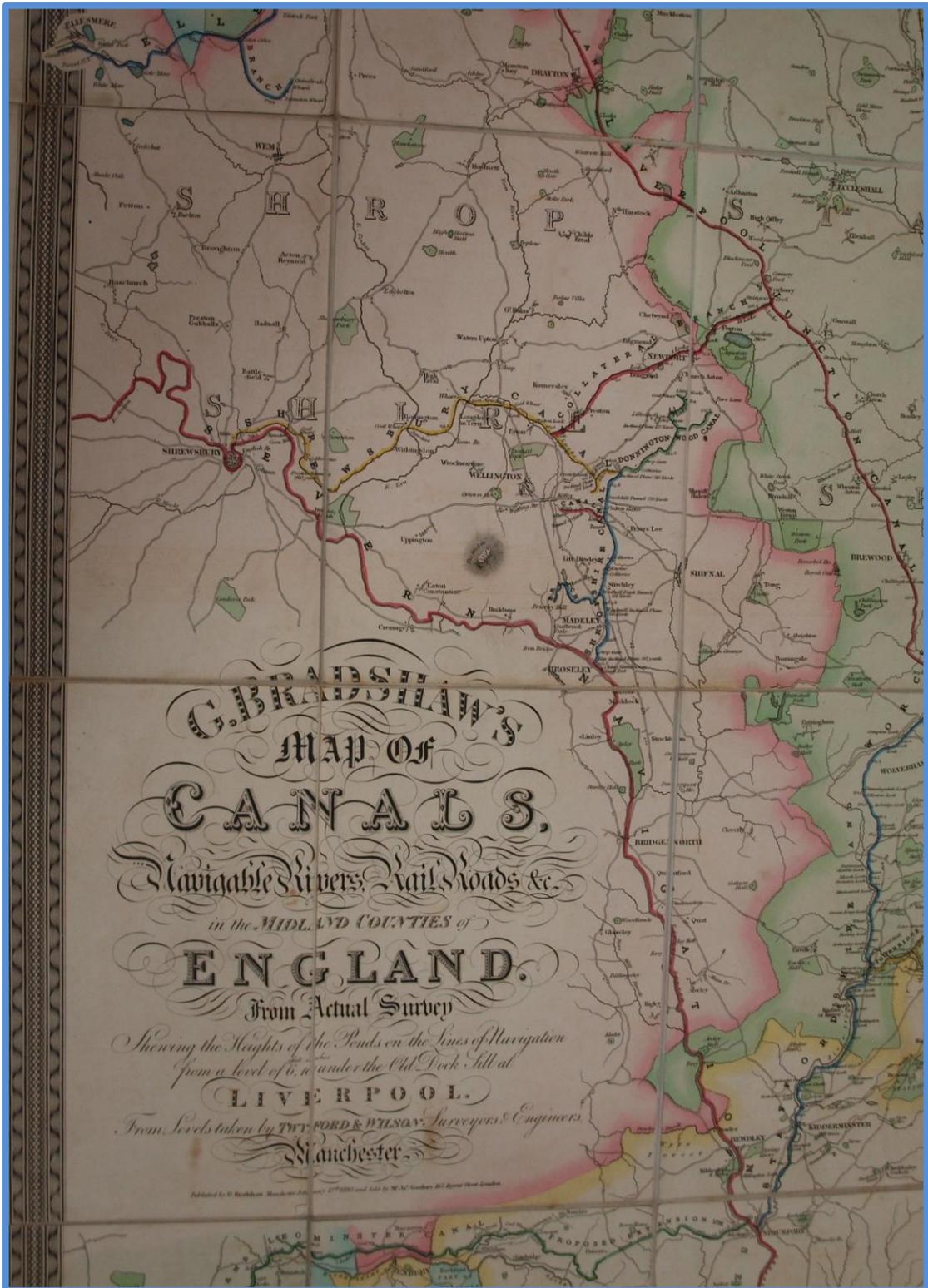
The canal at Bradley was the Birmingham Canal, running from Aldersley near Wolverhampton to Birmingham. Opened in 1770, by 1776 it had connections with the

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<sup>195</sup> Loch's involvement in agricultural improvement are addressed in 'Chapter 5- Agricultural Improvement;' Reynolds' innovative activities as an ironmaster and engineer are included in 'Chapter 4- The industrial dimension of intellectual activity.'

<sup>196</sup> Ironbridge Gorge Museum Library, Transcription of Samuel More's Journal, 12 July 1776,' p.1 (original journal p.5-6).

Image: 3/2



The East Shropshire Canals, from: Bradshaw, G., *Map of Canals, Navigable Rivers, Railroads, etc in the Midland Counties*, (Liverpool, 1830).

Staffordshire and Worcester Canal and thereby the Trent and Mersey Canal and River Severn and it afforded industrialists a generally more reliable and sometimes speedier means of getting their goods to customers or ports. The Birmingham historian William Hutton noted of the Birmingham Canal: ‘This watery passage ...tends greatly to the improvement of some branches of trade, by introducing heavy materials at a small expense, such as pig iron for the foundries, limestone, articles for the manufacture of brass and steel, also stone, slate, timber, etc.’<sup>197</sup> The most quoted measure of the Birmingham Canal’s immediate economic influence on trade is that the price of coal delivered to Birmingham fell by 65 to 75 per cent following its opening.<sup>198</sup> John Wilkinson’s support for schemes for road improvement, bridges and canal construction epitomised his attitude to economic progression and the advancement of knowledge and he invested heavily in the Shropshire canals and the first iron bridge. Financial benefit from canal transportation was not restricted to industrialists. The Marquis of Stafford’s annual income from his inherited life interest in the Bridgewater Canal averaged around £70,000 and investment opportunities in canals were pursued by individuals across social and economic sectors.<sup>199</sup> The notion was promoted, probably with a degree of substance, that the introduction of canals represented a beneficial advancement for the greater good, as witnessed in the 1790s by declarations in respect of the Ellesmere and Montgomeryshire Canals.<sup>200</sup> But whilst the opportunities that canals afforded persuaded industrialists and landowners to embark on canal construction in some parts of the country, Shropshire counterparts were initially less convinced of the need.

The utilisation of rail roads within the coalfield obviated the need for further local transport systems and the proximity of the Severn provided the solution for more distant destinations.

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<sup>197</sup> Hutton, W., *History of Birmingham* (Birmingham, 2<sup>nd</sup> ed. 1783), p. 267.

<sup>198</sup> *Aris’s Birmingham Gazette*, 14 May 1770, cited in Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969).

<sup>199</sup> Checkland, S. G., in Richards, E., *The Leviathan of Wealth* (London, 1973), p. ix.

<sup>200</sup> see later in this chapter.

There was also little progress in enhancing the means for shipment of goods in a direction away from the River Severn other than by improved roads. As the demand for iron and its raw materials increased, the constraints of the system of river and rail transportation, and roads frequently rendered impassable by the impairments inflicted by heavy haulage, must have been apparent. Whilst considering canal construction in the county a distinction has to be made between private, local canals and those utilised for transport of goods on a wider basis. The earliest reaction in Shropshire to the opening of England's first navigable canal by the Duke of Bridgewater in 1761, was the creation by the Duke's brother-in-law, Earl Gower, of a 'tub-boat' canal on his Lilleshall estate (see Image 3/2).<sup>201</sup> It ran for five and a half miles from mines at Donnington Wood to Pave Lane and opened in 1767. The tub-boat from which the name was derived was a rectangular cuboid shape, generally twenty feet by six feet four inches in dimension and capable of carrying, depending on depth, between three and eight tons of raw materials or products. They were linked stem-to-stern and pulled by horse. Lord Gower had provided finance for the Bridgewater Canal and his agent, John Gilbert, was instrumental, with the engineer James Brindley, in bringing it to fruition.<sup>202</sup> All three contributed to campaigning for and constructing other canals including the Trent and Mersey, which had greater potential and enjoyed wider support than anything Shropshire might offer at that time. The Donnington Wood Canal had limited use within the confines of the Gower estate, from the point of its conception until it was incorporated into the tub-boat network in 1788. It had in part been influenced by the Brindley design for material movement on the

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<sup>201</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969), p. 40; Trinder, B., *The Industrial Revolution in Shropshire* (Chichester, 3<sup>rd</sup> ed. 2000), p. 63.

<sup>202</sup> Richards, E., *The Leviathan of Wealth* (London, 1973), p. 42.

Bridgewater Canal at Worsley, where Gilbert was also agent and accordingly Brindley may have either directly or indirectly contributed to its completion.<sup>203</sup>

The creation of local ‘tub-boat’ canals were a peculiarly Shropshire phenomenon in eighteenth-century England, with the possible exception of the Worsley mines on the Bridgewater Canal and were an effective means of transporting material.<sup>204</sup> It was, however, more than twenty years before the next two Shropshire tub-boat canals were completed in 1788 and it is worth considering the state of canal-building in other parts of the West Midlands region following the Bridgewater initiative:

<b>Fig: 3/1</b>			
<b>Canal</b>	<b>Empowering Act</b>	<b>Date of Completion</b>	<b>Length of main line</b>
Birmingham	1768	1772	22 miles
B’ham & Fazeley	-	1789	20 miles
Staffs & Worcester	1766	1772	46 miles
Stourbridge Canal	1776	1779	5 miles
Trent & Mersey	1766	1777	93 miles

West Midland Canal Construction , 1770s/80s- Details taken from: Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969,), p 318-327.

Major transport arteries had been established in other parts of the region, none of which the industrialists in Shropshire had access to, other than by the circuitous route of the Severn and the Staffordshire and Worcester Canal from Stourport. When industrialists recognised the merits of canal transport in Shropshire the nature of innovation employed to tackle the particular issues that they faced, was notable. The tub-boat canals completed in 1788 were

<sup>203</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969,), p. 40; Trinder, B., *The Industrial Revolution in Shropshire* (Chichester, 3<sup>rd</sup> ed. 2000), p. 41..

<sup>204</sup> Checkland, S. G., in Richards, E., *The Leviathan of Wealth* (London, 1973), p. ix.

located on the East Shropshire coalfield and constructed by William Reynolds to provide a ready-supply of raw materials to the furnaces.<sup>205</sup> The Wombridge Canal ran from Donnington Wood to Wombridge Farm, a distance of a mile and three-quarters and cost £1,640 to complete. That cost compared with around a thousand pounds per mile claimed by Samuel More to lay a single track of iron rail road.<sup>206</sup> All other factors being comparable it leads to the surprising conclusion that canal construction was marginally less expensive than a railroad.<sup>207</sup> Why Reynolds chose to construct the canal rather than extend the network of railway track is not clear but Hadfield suggests that the proximity of the Donnington Wood Canal and the potential for a more extensive network was probably influential.<sup>208</sup> In 1788 the Shropshire iron industry produced around twenty five thousand tons of iron, 38 per cent of the national output and the perception may have grown amongst ironmasters that improvement and flexibility in the means of movement of materials and output were needed.<sup>209</sup> At what point the conception of a more extensive network of canals to service the wider coalfield took shape with Reynolds, is not known but by the time the construction of Wombridge and the shorter Ketley Canal were reaching completion in 1788, he was writing to his cousin, William Rathbone:

...we are making a canal from Oakengates to Ketley and have between 2 and 300 men at work upon it & as I am head and subschemer, Engineer and Director & have besides one in contemplation from the same place to the river wch I have been obliged to Levell & relevell, survey & resurvey I have had scarce time to do anything but think of them.<sup>210</sup>

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<sup>205</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 151; Trinder, B., *The Industrial Revolution in Shropshire* (Chichester, 3<sup>rd</sup> ed. 2000), p. 63.

<sup>206</sup> Ironbridge Gorge Museum Library, *Transcription of Samuel More's Journal, 15 July 1776,* p. 4 (original journal p.17).

<sup>207</sup> More's cost is significantly greater than the £150 per mile supplied by Abraham Darby II to Thomas Goldney of Bristol. This calculation was in respect of a wooden rail way laid in 1757, Stembridge, P. K., *The Goldney Family: a Bristol Merchant Dynasty* (Bristol, 1998), p.75.

<sup>208</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 151; Trinder, B., *The Industrial Revolution in Shropshire* (Chichester, 3<sup>rd</sup> ed. 2000), p. 152.

<sup>209</sup> Cited in Trinder, B., *The Industrial Revolution in Shropshire* (Chichester, 3<sup>rd</sup> ed. 2000), p. 40.

<sup>210</sup> Rastrick, A., *Dynasty of Ironfounders* (London, 1953), p. 189.

Agreement was reached with the Lilleshall Company in May 1788 on undertaking the longer Shropshire Canal to the Severn and connections with Donnington Wood, Wombridge and Ketley canals were effected as part of its construction.<sup>211</sup> Reynolds may, however, have had more far-reaching ideas in completing the Wombridge Canal than merely improving the supply of raw material to his furnaces. Paul Luter suggests that Reynolds' chemical experimentation had instilled in him the desire to establish an integrated chemicals operation where bi-products of one process formed constituents of another.<sup>212</sup> Manufacturing facilities would be located in close proximity and materials transferred by way of tub-boat. Such was a plan discussed by Reynolds and Lord Dundonald for Coalport after the completion of the Shropshire Canal in December 1799, but Luter suggests the idea was first planned for Wombridge.<sup>213</sup> He highlights the sulphuric acid works at Wombridge run by John Biddle, in which Reynolds was a partner; a glassworks in which he held an investment; a flint mill and two brick kilns in addition to the Donnington Wood furnaces, all of which bordered the Wombridge Canal. In the event, whether planned for Wombridge or Coalport, the death of William Reynolds in 1803 removed its strongest advocate.

The Ketley Canal was slightly shorter in length than the Wombridge Canal at one and a half miles and its most significant feature was the building by Reynolds of the first canal inclined plane in Britain. The American engineer, Robert Fulton commented on the 'genius of Mr William Reynolds' and this 'visionary project...(which) will in many instances supercede lock canals.'<sup>214</sup> It was 'an ingenious combination of an inclined plane and locks,' to facilitate the boats entering and leaving the upper waterway. The process was powered by the weight of

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<sup>211</sup> Staffordshire Record Office, Ref: D593/B/11/7 'Agreement for the use of a canal under construction to serve Ketley Iron Works',

<sup>212</sup> Luter, Paul, 'The Wombridge and Ketley Canals' in W. M. Reynolds 1758-1803, 'Proceedings of events held in June 2003 to commemorate his life achievements (Wrekin Local Studies Forum, 2004.)'

<sup>213</sup> Trinder, B., *The Industrial Revolution in Shropshire* (Chichester, 3<sup>rd</sup> ed. 2000), p. 95; Luter, P., 'The Wombridge and Ketley Canals,' in 'William Reynolds 1758-1803; Proceedings of events held in June 2003 to commemorate his life achievements,' Wrekin Local Studies Forum, 2004.

<sup>214</sup> Fulton, R., *A Treatise of the improvement of Canal Navigation exhibiting the numerous advantages to be derived from Small Canals...* (London, 1796).

the controlled descent of a laden boat which in turn raised an empty boat from the bottom of the incline. It was similar in concept to the railway inclined plane described by More in 1776.<sup>215</sup> Fulton concludes: ‘Every future improver will feel infinitely indebted to MR REYNOLDS; however greatly his engine may be improved in construction or varied in its operation.’ There has been conjecture concerning the inspiration for Reynolds’ design of the inclined plane, including unsuccessful examples in Tyrone and Bude.<sup>216</sup> Having experience of the construction of primitive railways the simplest solution seems more likely, in that he adapted from what he knew. Hadfield considers the Ketley Canal to have doubled as a forerunner for the longer Shropshire Canal being considered for construction from Donnington to the Severn.<sup>217</sup> Given the undulating topography of the land to the river, through which the Shropshire Canal would be constructed, extensive use of locks would be required and the adequacy of water supplies for their operation was in doubt. The successful performance of the Ketley inclined plane resolved that issue and in autumn 1788 construction commenced.

The Shropshire Canal was the first in the county to invite public subscription and industrialists duly invested.<sup>218</sup> The major landowners were apparently not sufficiently imbued with the spirit of improvement or the economic prospect of investment. The exception was the Marquis of Stafford who had direct interest in industry that would be served by the Canal. William Reynolds had admitted to his cousin to having primary responsibility for the canal’s design, planning and construction; however the design of inclined planes for the canal was put out to competition. The final design by Henry Williams and John Lowdon was a variation of the Ketley inclined plane, with the introduction of a reverse slope at the top and the

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<sup>215</sup> See page 48 above.

<sup>216</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 152; Hadfield, C., *Thomas Telford's Temptation: Telford and William Jessop's Reputation* (Shropshire, 1993) p. 15.

<sup>217</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 153.

<sup>218</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 153

application of a steam engine to assist heavy loads to ascend.<sup>219</sup> It was utilised for three inclined planes on this canal and later introduced on the Donnington Wood and the Shrewsbury canals. The invitation to John Curr in 1793 to advise on the western branch terminus of the canal at Brierley Hill resulted in changes being made but by the end of the year the utilisation of tunnels and shafts for the transfer of goods to and from the river, was run down and replaced by a railway incline.<sup>220</sup> The canal builder, William Jessop, assisted in the presentation of the case for an act of Parliament and may have visited the county for discussions on the application and even view the proposed route.<sup>221</sup> There is, however, no evidence to that effect. Reynolds was not a surveyor by training and with the terrain of the Shropshire Canal being difficult, the assistance of one of Britain's foremost civil engineers would have been invaluable. The conception of Coalport as an industrial entrepot was inspired and although the ambition of Reynolds and Lord Dundonald for an integrated chemical complex did not materialise, a number of businesses were established. Much of the output of the East Shropshire coalfield was routed through Coalport. Approximately 50,000 tons of coal, per annum were distributed through Coalport around 1800, in addition to iron and other products, reflecting the contribution the Shropshire Canal made to the regional economy in the late eighteenth century.<sup>222</sup> It also furnishes evidence of infrastructure improvement being reliant upon intellectual advancement. The endeavours of the Gilberts, Reynolds, Dundonald, Williams, Curr, and others so far unidentified, in the establishment of these canals, added to the intellectual resource available within the region.

The construction of the Shrewsbury Canal from 1793 was intended to ease the supply and cost of coal to the county town. Running some seventeen miles from Donnington Wood its

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<sup>219</sup> Trinder, B., *The Industrial Revolution in Shropshire* (Chichester, 3<sup>rd</sup> ed. 2000), p. 67.

<sup>220</sup> Trinder, B., *The Industrial Revolution in Shropshire* (Chichester, 3<sup>rd</sup> ed. 2000), p. 70.

<sup>221</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969), p. 153.

<sup>222</sup> Plymley, J., *A General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1803), p.64

purpose bore the imprint of social imperative and consequently Enlightenment convictions. Of interest to this study are several notable elements introduced to the debate on improvement and the contemporary transfer of knowledge but it also confirmed the Shropshire county surveyor, Thomas Telford, as a civil engineer. Trained as a stonemason and architect, his early work after appointment as Shropshire County Surveyor had centred on street improvements, private housing, improvements to the county infirmary, drainage and the construction and renovation of church buildings. His first completed construction was the masonry bridge at Montford near Shrewsbury. Prior to his installation as engineer to the Shrewsbury Canal Company in February 1795, Telford had been appointed to the role of agent, architect, engineer and overseer on the Ellesmere Canal. By February 1795, however, his part-time responsibilities on the Ellesmere Canal appear to have been largely surveying and organisational. The Shrewsbury Canal, in contrast, and local enquiries into the properties and use of iron, brought him into the realm of the ironmasters.<sup>223</sup> It represented a major change in the career direction of Telford who had hitherto little practical experience in the use of structural iron and he became one of the foremost exponents of his generation in its utilisation.

The collaborations and the dissemination of knowledge, frequently across disciplines, fostered innovation that had far-reaching implications for infrastructure development. Experiments were initiated on the ductile strength of iron at Ketley in March 1795 and the following month on twenty-nine foot curved ribs of iron at Coalbrookdale.<sup>224</sup> The information arising from these tests was being freely disseminated and consequently attracted the interest of ironmasters and engineers from wider-afield than Shropshire. The itinerant lecturer, John Banks, wrote: ‘The following experiments were given to me by Messrs Reynolds of Ketley, at

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<sup>223</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 169: See references to tests on iron conducted at Ketley and Coalbrookdale in the following paragraph.

<sup>224</sup> Banks, J., *On the power of machines etc.* (London, 1803), pp. 89-91.

the same time requesting me to make them as public as I could, for the advantage of others.<sup>225</sup> William Jessop and Benjamin Outram, partners in the Butterley Iron Company of Derby since 1792 and Robert Fulton, all experienced civil engineers, visited around this time and were all soon associated with the application of iron in construction projects.<sup>226</sup> On 14 March 1795 the committee of the Shrewsbury Canal accepted a proposal for an iron water-trough to be incorporated into the aqueduct at Longdon-on-Tern. In April Shropshire justices awarded a contract to the Coalbrookdale Company for an iron bridge to be built over the Severn at Buildwas to Telford's design. In the same month Robert Fulton, the engineer on the Peak Forest Canal in Derbyshire, recommended substituting iron for masonry on the Marple aqueduct. Benjamin Outram was also involved in the Peak Forest Canal construction for which his Butterley Iron Company produced the ironwork. On 11 June 1795 the Derby Canal Company authorised an aqueduct forty-four feet in length at Holmes. In the event Holmes aqueduct was completed a month earlier than Longdon, in February 1796, thereby establishing primacy as the first navigable iron aqueduct. In addition to the expansion of knowledge arising from these tests, the philosophy of making the results available to others echoes Enlightenment sentiments in their employment for the greater good.

William Reynolds was the driving force for the construction of the Shrewsbury Canal and upon appointment Telford was required to work in consultation with him. After several meetings 'and forming and considering various plans,' Telford recorded that they had at last determined the design of Longdon-on-Tern aqueduct.<sup>227</sup> The utilisation of iron in that environment was a highly innovative step and in his contribution to Plymley's *General View*, Telford credited Thomas Eyton, the canal committee chairman, with first suggesting the use

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<sup>225</sup> Banks, J., *On the power of machines etc.* (London, 1803), p. 89.

<sup>226</sup> Davidson, I., *Transactions of the Newcomen Society*, Vol 51 (1978-9), p. 141; Hadfield, C. and Skempton, A. W., *William Jessop Engineer* (London, 1979), pp 44-6.

<sup>227</sup> Plymley, J., *A General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1803), p.300.

of iron for Longdon.<sup>228</sup> Eyton was a landowner and banker rather than an industrialist and his credentials for making an informed proposal on such an issue seem questionable. In the absence of evidence of pertinent experience it seems more likely that the suggestion was conjecture rather than a formulated proposition and made in the light of ongoing debates. In the event, having agreed to proceed with the concept of an iron trough at Longdon, the committee referred the determination of its form and completion to Reynolds and Telford. Arnold Skempton surmised that the tests carried out at Ketley in March 1795 were specifically associated with Longdon aqueduct which would be understandable given their timing and Reynolds' roles in the management of the ironworks and the canal.<sup>229</sup> Another attribution of influence over the utilisation of iron at Longdon is directed at Pont-y-Cafnau Bridge at Merthyr Tydfil, Glamorgan.<sup>230</sup> Completed in 1793 for the ironmaster Richard Crawshay it carried water and limestone across the River Taff into the Cyfarthfa ironworks. Crawshay was friendly with Reynolds, John Wilkinson and Lord Dundonald, staying at Ketley in 1790 and knowledge of this construction would at some point have been known by those men.<sup>231</sup> A sketch of the bridge exists in Reynolds' extant sketch book but is undated.<sup>232</sup> At forty-seven feet in length, the Pont-y-Cafnau trough was significantly shorter and smaller in profile than required for the aqueduct at Longdon and the capability of iron to bear the stresses involved would undoubtedly have been of concern to Reynolds and Telford, until the tests at Ketley had been undertaken. A technical innovation employed by Reynolds to strengthen the Longdon construction, was the casting of the iron plates with a flanged-edge through which connecting bolts would be applied rather than utilising a simple weld joint.

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<sup>228</sup> Plymley, J., *A General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1803), p. 300.

<sup>229</sup> Skempton, A. W., 'Telford and the design for a new London Bridge,' Penfold, A. (ed.), *Thomas Telford, Engineer* (London, 1980), p. 75.

<sup>230</sup> Hadfield, C., *Thomas Telford's Temptation: Telford and William Jessop's Reputation* (Shropshire, 1993) p. 79.

<sup>231</sup> Evans, C., *The letterbook of Richard Crawshay, 1788-1797* (Cardiff, 1990), Richard Crawshay to William Reynolds, 4 August 1790, p.70;

<sup>232</sup> Dickinson, H. W., 'An Eighteenth-century engineer's sketch book,' *Transactions of the Newcomen Soc*, vol. 2, 1921-22, pp. 132-40.

Whether or not Pont-y-Cafnau represented a direct influence on Longdon, it demonstrates the geographical extent of knowledge exchange that prevailed amongst engineers.

Engineering innovation features in the construction of the Shrewsbury Canal in several other areas. The Berwick Tunnel was nearly one thousand yards long and the first to have a towpath. The tunnel itself was designed by the canal's original engineer, Josiah Clowes, but the provision of a towpath was recommended by Reynolds in order to avoid the need for 'legging,' that is operatives lying on their backs and walking along the walls to propel the boats forward. The towpath was situated so as to allow the water to flow underneath it, as in the later Ellesmere Canal, and had connotations of the application of Bernoulli's Theorem.<sup>233</sup> In references to the eleven sets of locks on the canal, Telford described them as opening vertically: known in modern terminology as 'guillotine' locks.<sup>234</sup> He also indicated that the eighty-one foot long locks had a supplementary gate positioned at their mid-point to render the lock capable of being divided into two halves. Such a configuration of guillotine lock and a mid-point gate avoided unnecessary loss of water when the lock contained less than its optimum number of four boats. Concerns over the availability of adequate water for the operation of the canal occupied Telford's mind and such a design would have been an innovative attempt to address the problem.<sup>235</sup> Hadfield, however, expresses reservations over whether they were fitted, given a lack of archaeological evidence.<sup>236</sup> He suggests that Telford may have included a statement of designed intentions in his narrative and not what transpired. Plymley's *General View* was, however, published in 1803, significantly post-dating the opening of the canal in March 1796 and there seems no obvious rationale for Telford identifying other than what had been constructed.

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<sup>233</sup> See page 86.

<sup>234</sup> Telford, T., in Plymley, J., *A General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1803), p. 299.

<sup>235</sup> Telford, T., in Plymley, J., *A General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1803), p. 290.

<sup>236</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969), p. 161.

The Trench canal inclined plane was a further application of the design concept employed on the Shropshire Canal and was two hundred and twenty-three yards long.<sup>237</sup> It remained in operation until 1921 by which time it was the last example functioning in Britain.<sup>238</sup> The connection of the East Shropshire canal system with the national network did not occur until 1835 when a branch from the Birmingham and Liverpool Junction Canal was made by way of Newport to the Shrewsbury Canal. The improved flexibility in the distribution of materials and goods and the wharfage offered at places along the branch line, served both industrialists and retailers.<sup>239</sup> It shortened movement times and offered options in terms of the geographical direction and method of distribution. Above all the system added capacity at a time when the volume of output from the coalfield area was still increasing. The junction of the coalfield system with the national network represented a linear expansion and did not necessitate increases in knowledge or innovation to accomplish it. It provided a noticeable improvement in the system and its performance, but it is difficult to perceive the change in Enlightenment terms.

The American engineer, Robert Fulton commented that the English had adopted the idea of canals later than other places in Europe, such as France and the Netherlands, but had done so with enthusiasm.<sup>240</sup> Other than the Donnington Wood Canal, where family connections with the Duke of Bridgewater were influential, Shropshire industrialists and the social elite were slower than others in recognising the potential benefits of canal transport. The eventual inception of canal-building in Shropshire arose through a fortuitous combination of individuals and their perception that canals could remove constraints from the industrial process: namely improved transportation of raw materials and products. As will be observed

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<sup>237</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 163.

<sup>238</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 163.

<sup>239</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 164; Trinder, B., *The Industrial Revolution in Shropshire* (Chichester, 3<sup>rd</sup> ed. 2000), p. 129

<sup>240</sup> Fulton, R., *A Treatise of the improvement of Canal Navigation exhibiting the numerous advantages to be derived from Small Canals...* (London, 1796).

in the following chapter, a substantial expenditure of mental energy in the 1790s was centred upon the ironworks of Shropshire. Engineers and ironmasters engaged in the extension of technical knowledge and production processes and drew into their sphere many others who sought the opportunity for collaboration. It demonstrates the permeability of boundaries in the dissemination of knowledge; boundaries both geographical and thematic. The transfer of a level of technical understanding from the iron industry to structural construction and to transport technology was witnessed; burgeoning scientific knowledge in such as metallurgy was similarly conveyed. The transmission of knowledge did not flow one way. Empiricists brought the results of their experiments and the likes of Jessop, Crawshaw and de Betancourt, who had no particular association with Shropshire, through their involvement with Telford and Reynolds, contributed to the development of regional infrastructure. Improved features and innovations in design aside, the construction of a short industrial canal may not seem indicative of a pursuit of Enlightenment sensibilities aimed at human betterment. They seem more indicative of the advancement of personal profit. Construction of the Shrewsbury Canal, however, was predicated on the supply of coal to the county town; consistently and at a reasonable price, which may be considered adherence to an Enlightenment principle of advancement for the greater good. Some innovations were not successful, such as the tunnels and shafts employed at Brierley Hill but the commitment to the attempt reflected the age and Kant's assertion that it was 'the active and critical engagement of the individual that mattered.'<sup>241</sup>

In examining the course of infrastructure improvement the role of landowners is frequently significant. They owned the land over, or through which, the transport networks ran and the rights to minerals upon which economic progression in eighteenth-century Shropshire was

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<sup>241</sup> Cited in Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p. 7.

dependent. That ownership was on occasions secured by a parliamentary enclosure act but, unlike some counties, it was a procedure that was not extensively applied in Shropshire with regard to open-field sites: these had been undertaken before 1750.<sup>242</sup> Most subsequent enclosure legislation within the county related to the securing of title rights to wastes or prevention of encroachment, with the aim of bringing the land into productive use.<sup>243</sup> A sense of social obligation is identifiable in some members of the elite and improvement was sometimes provoked by social imperative.<sup>244</sup> Whether the interpretation of a sense of obligation by Shropshire landowners was manifested along political lines, as David Brown asserts was the case elsewhere, is less clear.<sup>245</sup> He also claims that attempts to justify status occasioned the patronage of canals, turnpikes and enclosures.<sup>246</sup> He gives little significance to economic considerations of engagement in such ventures, a factor to which Rowland Hunt of Boreatton saw fit to draw attention in his oration at the opening of the Pontcysyllte aqueduct: 'The path of prosperity is laid down...let it be for the happiness of the individual, as well as your own- let it be a service, and not a sacrifice- let the health and future well-being of the youth be a consideration, as well as immediate profit.'<sup>247</sup>

In many instances, however, personal interest retained priority, rather than adherence to the 'spirit of improvement.' William Childe, a noted agricultural improver, refused passage for a canal across his land, believing that no benefit would accrue to himself. A subsequent rail

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<sup>242</sup> Dodd, J. P., 'The state of agriculture in Shropshire 1775-1825,' in Transactions of the Shropshire Archaeological Society, lv 1954-56, pp. 1-31, p. 1; Tate, W. E. and Turner, M. E., *A Domesday of English enclosure acts and awards* (Redditch, 1978), pp. 223-6.

<sup>243</sup> See Chapter 5 'Agricultural Improvement.'

<sup>244</sup> Hunt, R. 'Report to the General assembly of the Ellesmere Canal Proprietors held at the Royal Oak Inn, Ellesmere on 27<sup>th</sup> day of November 1805 to which is annexed, The Oration, delivered at Pontcysyllte Aqueduct on its first opening, November 26 1805', Ironbridge Gorge Museum Library; University of Birmingham Cadbury Library, *Journals of R. A. Slaney, 1815-50*, Ref: RAS/1/1-5; Staffordshire Archives, *Sutherland Collection- chief agent's OUT letters- 1826*, Ref: D593/K/1/5/22, 'J. Loch to T. Fenton, 28 Nov 1826.'

<sup>245</sup> Brown, D. G., *Enclosure and Improvement: an investigation into the motives for Parliamentary enclosure*, Unpublished PhD thesis, Wolverhampton Polytechnic, 1992, p. 375;

<sup>246</sup> Brown, D. G., *Enclosure and Improvement: an investigation into the motives for Parliamentary enclosure*, Unpublished PhD thesis, Wolverhampton Polytechnic, 1992, p. 375

<sup>247</sup> Hunt, R. 'Report to the General assembly of the Ellesmere Canal Proprietors held at the Royal Oak Inn, Ellesmere on 27<sup>th</sup> day of November 1805 to which is annexed, The Oration, delivered at Pontcysyllte Aqueduct on its first opening, November 26 1805', Ironbridge Gorge Museum Library.

road was constructed in return for the granting of favourable wayleaves to Childe.<sup>248</sup> The early tub-boat canals were largely financed by industrialists and those members of the landed gentry whose economic interests in iron or mineral extraction were advanced by the construction of the canals. The 1<sup>st</sup> Marquis of Stafford and his partners, the Gilbert brothers, illustrate the point. The Shrewsbury Canal represented a change. The principal reason for the creation of the canal was to furnish the county town with a constant supply of coal and it afforded the opportunity for altruistic investment in a public service. The sixty-five original proprietors in the canal are a broad representation of social and economic life in the county, in as much as individuals have been identified (Appendix 3/1).<sup>249</sup> It is not evident, however, that any justification of social status was exercised through investment in this case. For example the investments of £1,000 by Lords Stafford and Berwick in the Shrewsbury canal are matched or exceeded by twenty gentlemen and industrialists. That may, however, be an inappropriate measure but it requires the emergence of documentary evidence to clarify individual reasoning behind the support for such ventures. Hadfield notes, perhaps ironically, that the passage of time occasioned a greater incidence of shareholding by citizens of Shrewsbury in the canal, in what proved to be a very steady investment.<sup>250</sup>

A more substantial infrastructure project, in terms of financial investment, geographical expanse and predominant features, was the Ellesmere Canal.<sup>251</sup> An examination of the innovations employed in its construction, the pivotal figures and the manner of its conception and completion affords the opportunity to consider it in the context of a number of questions: Whether the extent of the exchange of knowledge through communal activity was influential

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<sup>248</sup> Nair, G. and Poyner, D., 'The Coming of coal: Industrial development in a South-Shropshire parish,' *Midland History*, 18 (1993), p. 89.

<sup>249</sup> Shropshire Archives, Ref: 665/476, *List of original proprietors in Shrewsbury Canal*.

<sup>250</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 160.

<sup>251</sup> Upto 1805 £460,000 was spent on works, expenses and interest and the Ellesmere Canal system extended to nearly 70 miles - Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), pp. 179, 330-1; Hunt, R. 'Report to the General assembly of the Ellesmere Canal Proprietors held at the Royal Oak Inn, Ellesmere on 27th day of November 1805 to which is annexed, The Oration, delivered at Pontcysyllte Aqueduct on its first opening, November 26 1805', Ironbridge Gorge Museum Library.

in the creation of construction solutions; if applied improvements in design and construction were reliant on intellectual advances; and whether social imperative was a determining force in the construction.

### **3.4 Case Study- Pontcysyllte Aqueduct and the Ellesmere Canal**

**Image 3/3:**



**Pontcysyllte Aqueduct permission of Wrexham Borough Council**

#### **3.4.1 The case for the Ellesmere Canal**

On 31 August 1791 at Ellesmere, in the north-west of the county, a public meeting was held to discuss the prospect for a canal, the main line of which would run from the Mersey to the

Severn at Shrewsbury.<sup>252</sup> Initial discussions amongst the promoters of the canal centred upon the benefits for industrial and agricultural interests of a more reliable form of transport serving Shrewsbury and Chester and granting direct access to the sea.<sup>253</sup> At the opening ceremony for the Pontcysyllte Aqueduct on 26 November 1805 the committee chairman, Rowland Hunt, prophesied: ‘...Pontsycyllte is destined to convey the Riches of the mineral Kingdom into the World of Industry, and thence every part of the Universe.’<sup>254</sup>

The movement of materials, agricultural produce and trade goods between the Welsh border counties and Shrewsbury had long existed and the proposed construction of the canal represented improvement in communications within an integrated economic zone.<sup>255</sup> Twelve years after the granting of the act of empowerment in 1793 the prospect that Hunt faced at the opening of Pontcysyllte was a significantly different outcome to what the Act and the original promoters had determined (see Image 3/4).<sup>256</sup> Delay and changed economic circumstances had persuaded the committee in 1800 that the lines from Ruabon to Chester and from Weston to Shrewsbury were not economically viable.<sup>257</sup> The Ellesmere Canal’s engineer, William Jessop, considered the shipping of coal to the county town by way of the newly opened Shrewsbury Canal from Oakengates, a decisive factor in the decision not to proceed with that element of the main line. New, alternative sources of coal with cheaper transport costs similarly decreed the abandonment of completion of the line from Ruabon to Chester.<sup>258</sup>

Extensions to branch lines had connected the canal with the Montgomery Canal beyond

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<sup>252</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 167; Shropshire Archives, *Shrewsbury Chronicle*, Meeting at Ellesmere, 31 August 1791.

<sup>253</sup> Shropshire Archives, *Shrewsbury Chronicle*, Meeting at Ellesmere, 31 August 1791.

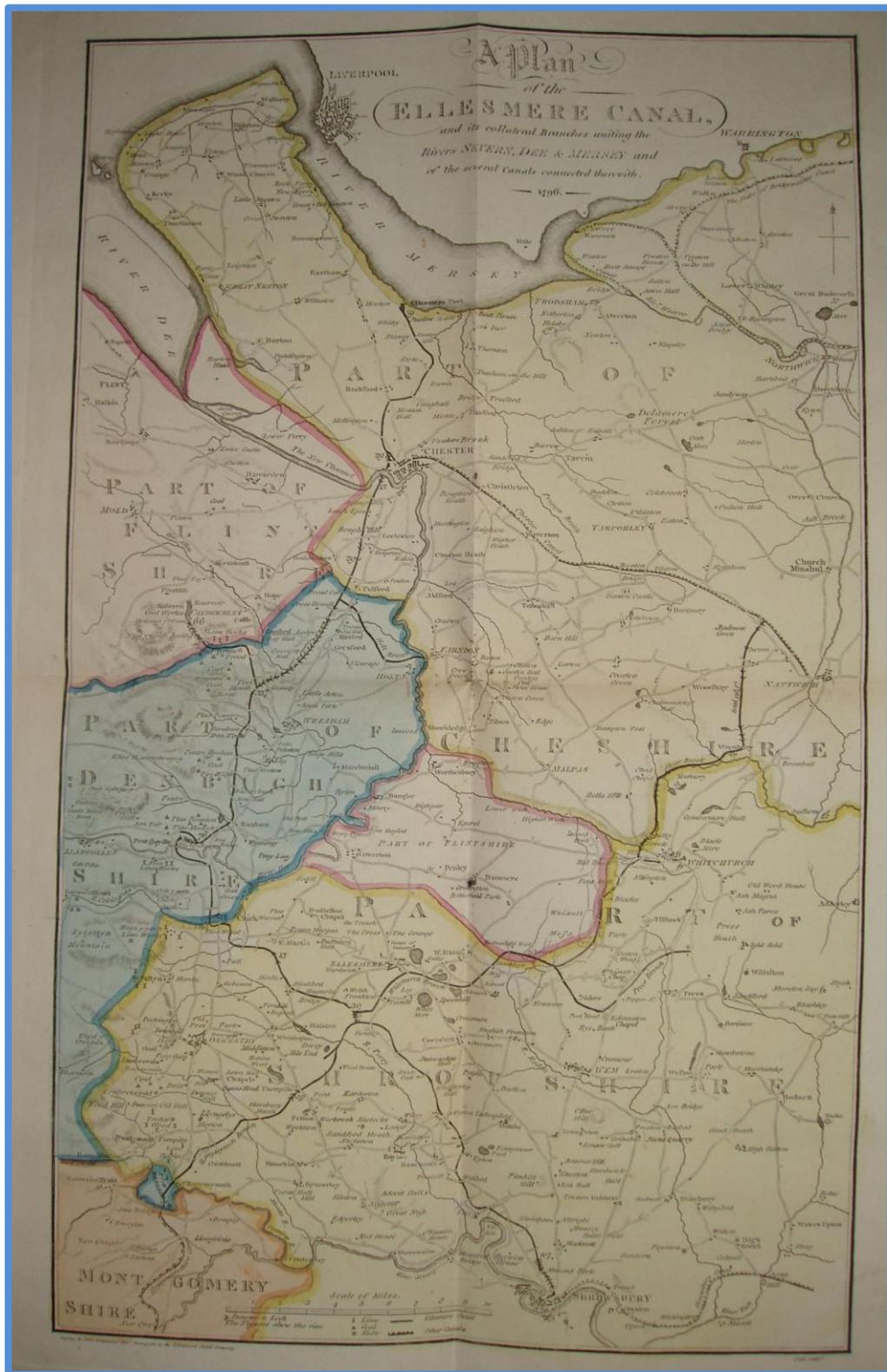
<sup>254</sup> Hunt, R. ‘*Report to the General assembly of the Ellesmere Canal Proprietors held at the Royal Oak Inn, Ellesmere on 27<sup>th</sup> day of November 1805 to which is annexed, The Oration, delivered at Pontcysyllte Aqueduct on its first opening, November 26 1805*’, Ironbridge Gorge Museum Library, p. 19.

<sup>255</sup> Telford, T., in Plymley, J., *A General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1803), p. 285.

<sup>256</sup> See map in Image 3/4 for the planned route of the canal in 1796.

<sup>257</sup> Shropshire Archives, 6000/15037, Jessop, W., *Report to the General Committee of the proprietors of the Ellesmere Canal Co*, 24 January 1800; Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969), pp. 163 & 176.

<sup>258</sup> Shropshire Archives, 6000/15037, Jessop, W. *Report to the General Committee of the proprietors of the Ellesmere Canal Co*, 24 January 1800; Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969), pp. 163 & 176..



Planned route of Ellesmere Canal 1796, from Report of the Committee of Ellesmere Canal Company: Oration on opening of Pontcysyllte Aqueduct 26th Nov 1805, Ironbridge Gorge Museum Library.

Llanymynech and, by the end of 1805, with the Chester Canal at Hurleston. Although circuitous, connection was now effected with Ellesmere Port and the Mersey estuary. Hunt's oratorical optimism was undoubtedly conditioned by the growth of trade afforded by these connections and the interconnecting plateway constructed to the mines and iron works of Bersham and Plas Kynaston. In this context the company had offered to purchase the Chester Canal the previous year, albeit to no avail.<sup>259</sup> In his oration at Pontcysyllte, Hunt made reference to the beneficial impact already witnessed in agriculture. He quoted an article from the *Shrewsbury Chronicle* of June 1802: 'Wherever the Spirit of Commerce had touched the mountains, (as in the scenery now around us) on the whole borders of Wales, "they began to smoke," and the extensive plain below was growing into vegetation, from the minerals which had descended from the mountains.'<sup>260</sup>

The poetic reference was to the burning of limestone with coal in order to produce lime for use as fertiliser, particularly on land that had not previously been productive. Telford wrote with regard to the construction of the Ellesmere Canal:

...that by far the most beneficial effects will follow from the influence which it will have upon the agriculture of the adjoining districts; and it is probably the first instance, in Great-Britain, in which extension and improvement in agriculture have been the principal motives that led to the forming a navigable canal of so great an extent, and where manufacturers, commerce and the trade of large towns, have been only secondary considerations.<sup>261</sup>

The statement accords with expressions of social responsibility on the part of landowners and promoters cited by David Brown: motivation being not solely directed in the pursuit of financial reward but a perceived obligation existing to contribute to improving society.<sup>262</sup> An

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<sup>259</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 178.

<sup>260</sup> *Shrewsbury Chronicle* June 1802

<sup>261</sup> Telford, T., in Plymley, J., *A General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1803), p. 302.

<sup>262</sup> Brown, D. G., *Enclosure and Improvement: an investigation into the motives for Parliamentary enclosure*, Unpublished PhD thesis, Wolverhampton Polytechnic, 1992, p. 375; see this chapter, p. 69

expression of such a rationalisation is offered by the promotion of the Montgomeryshire Canal. Local interests had determined that the Ellesmere Canal's proposed Llanymynech branch should be extended, in furtherance of the interests of agriculture and an act authorising the Montgomeryshire Canal was obtained in 1794. Little prospect existed of generating sufficient income from tolls to fund construction and as a consequence 'the Subscribers were the Noblemen and Gentlemen either possessed of estates in this Country, or resident therein, who had for their Object the Extension of Agriculture...;with the consequent Advantage to the Public.'<sup>263</sup> The extent to which similar sentiments were reflected amongst the ownership of the conjoined Ellesmere Canal is not known. Neither is it possible to determine the extent to which Ellesmere Canal shareholders followed their committee's supplication to support the Montgomery venture, for the greater good. The Member of Parliament for Montgomeryshire, Francis Lloyd of Domgay (1748-1799), was one who owned shares in both companies. At the time of his death he held five hundred pounds of stock in the Montgomeryshire Canal Company and a thousand pounds of stock in the Ellesmere Canal.<sup>264</sup>

Members of the local landed elite may have altruistically taken stock in the Montgomeryshire Navigation but Hunt reflects on the 'paroxysm of commercial ardour' that greeted the public share offer in the Ellesmere Canal.<sup>265</sup> In a single afternoon on 10 September 1792, almost a million pounds was subscribed. It is therefore necessary to impart a note of caution when judging the extent to which 'the greater public good' was foremost in considerations of investment in public infrastructure, as Telford declares. Economic events of the 1790s were widely conditioned by the cultural phenomenon of 'Canal Mania,' a feature of which was the

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<sup>263</sup> Institution of Civil Engineers library, *Case of the Montgomeryshire Canal...in respect of the proposed tax on inland navigation* (Shrewsbury, 1797), Tracts, 8vo, Vol. 98.

<sup>264</sup> History of Parliament Online. <http://www.historyofparliamentonline.org/volume/1790-1820/member/lloyd-francis-1748-99>, Lloyd, Francis (1748-99), of Domgay, Llantysilio, Montgomeryshire

<sup>265</sup> Hunt, R. 'Report to the General assembly of the Ellesmere Canal Proprietors held at the Royal Oak Inn, Ellesmere on 27<sup>th</sup> day of November 1805 to which is annexed, The Oration, delivered at Pontcysyllte Aqueduct on its first opening, November 26 1805', Ironbridge Gorge Museum Library, p. 19. Charles Hadfield recorded that the sum remitted by hopeful investors amounted to £967,700, three quarters of which was returned upon the scaling down of applications. Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 168.

fervent demand for shares in canal companies. Evaluation of investment in terms of Enlightenment ideals are rendered difficult in the absence of appropriate supportive expressions. Distinctions between the pursuit of financial advancement through engagement in the process of commercial development; altruistic investment; and speculation merely on the fluctuation of share prices, should be recognised.<sup>266</sup> In reality financial commitments may have been influenced by elements of all the above frameworks. Adam Smith offered an enlightened rationalisation of such paradoxes, declaring that self-interest and regard for others were not mutually exclusive considerations.<sup>267</sup> It is, however, appropriate to consider who the original promoters of the Ellesmere Canal were.

Twelve people were identified as promoters of the Ellesmere Canal following meetings in September 1792, each to the sum of £1,000 (Appendix 3/2). Six had landed estates, four of whom were members of Parliament; four were, or became, baronets; two were clergymen and one was the former mayor of Shrewsbury. They included a solicitor with a landed Shropshire estate, an engineer and John Wilkinson the ironmaster. A shrewd businessman, Wilkinson recognised the need for improved infrastructure in order to enhance the prospect of trade. He was one of the original investors and promoters of the Iron Bridge in the Severn Gorge and had taken shares in the Shrewsbury, Shropshire and the Flint Coal canals.<sup>268</sup> He was also an agricultural improver on his estate at Castle Head, Cumberland.<sup>269</sup> Sir Richard Hill of Hawkestone (1732-1808) was an Anglican evangelical who nevertheless maintained a respect for dissenting religious opinion.<sup>270</sup> Politically a supporter of William Pitt, it was claimed that

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<sup>266</sup> Kramnick, I., *The Portable Enlightenment Reader* (London, 1995), p. x.

<sup>267</sup> Smith, A., in *The Theory of Moral Sentiments* (Dublin, 1759) and *An enquiry into the nature and causes of the wealth of Nations* (Edinburgh, 1776)

<sup>268</sup> Trinder, B., *The Industrial Revolution in Shropshire* (Chichester, 3<sup>rd</sup> ed. 2000), p. 99; Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), pp. 47, 153, 160.

<sup>269</sup> Dickinson, H. W., *John Wilkinson, Ironmaster* (Ulveston, 1914) p. 34; Birmingham Archives and Heritage, Ref: MS 3782/12/79/43, Letter J. Watt to M. Boulton, 25th November 1785.

<sup>270</sup> Sydney, W. C., 'Hill, Sir Richard, second baronet (1733-1808)', rev. S. J. Skedd, *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edn, Jan 2008 [<http://www.oxforddnb.com/view/article/13290>, accessed 21 March 2013]

he had a benevolent nature and was given to generosity and philanthropy.<sup>271</sup> John Bishop was a former mayor of Shrewsbury. Described as a mercer and a gentleman, he was a partner with William Reynolds and Thomas Eyton in a bank at Wellington.<sup>272</sup> He also appears in a number of legal documents as a trustee or ‘assignee in bankruptcy,’ a court official deputed to deal with a bankrupt’s property during a period of bankruptcy.<sup>273</sup> Sir John Kynaston (Powell) was an anti-Catholic Tory MP and was claimed to be possessed of integrity and urbanity.<sup>274</sup> There is no transparency in the observable life-styles or actions of these promoters that makes obvious their attitudes to social improvement. Neither is the extent to which investment in the Ellesmere Canal may have been considered by any of them, as beneficial to the common good. Of all of the promoters, Rowland Hunt of Boreatton gives identifiable expression to consideration for the less fortunate, as witnessed at the opening of the Pontcysyllte aqueduct.<sup>275</sup> He was a JP and commissioner for the construction of the new Shrewsbury gaol and House of Correction, in association with John Howard the prison reformer.<sup>276</sup> He had an extensive library of more than one thousand titles, consisting of an eclectic selection of works; classics, religion, law, modern novels, biographies and poetry all featured.<sup>277</sup> More than a hundred titles were in French and there were several volumes by Voltaire and Montesquieu. There were a selection of works on rural economy by Arthur Young and William Marshall and on science by Ferguson and Macquer. Bentham’s *Oration*s and works by John Howard were also present. Much of the content of the library was possibly inherited, given the

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<sup>271</sup> Wraxall, N., *The historical and posthumous memoirs of Sir Nathaniel Wraxhall* (London 1884).

<sup>272</sup> Shropshire Archives, Ref: 665/2/7/6/336, *Articles of partnership between William Reynolds, Thomas Eyton and John Bishop...*, 18 May 1792.

<sup>273</sup> For example: Shrewsbury Archives, 3651/E/1/1/14, *Reconveyance of mortgaged estates in and near to the town of Shrewsbury; John Herbert esq to Messrs Bishop and Powell, assignees of Joshua Blakeway, a bankrupt, 25 March 1794; 5216/6A/1-2, John Bishop of the town of Shrewsbury, Gentleman...*

<sup>274</sup> Kynaston Powell, Sir John, 1st bt. (1753-1822), of Hardwick Hall, Salop., History of Parliament Online <http://www.historyofparliamentonline.org/volume/1820-1832/member/kynaston-powell-sir-john-1753-1822>.

<sup>275</sup> Hunt, R. ‘*Report to the General assembly of the Ellesmere Canal Proprietors held at the Royal Oak Inn, Ellesmere on 27<sup>th</sup> day of November 1805 to which is annexed, The Oration, delivered at Pontcysyllte Aqueduct on its first opening, November 26 1805*’, Ironbridge Gorge Museum Library.

<sup>276</sup> Foster, Joseph, *Alumni Oxoniensis: The members of the University of Oxford, 1715-1886* (Oxford, 1888-1892), Ancestry.com, *Oxford University Alumni, 1715-1866*, <http://search.ancestry.co.uk/>; Shropshire Archives, Ref: Q/A/11/1/8, Minutes of meetings of the Commissioners appointed under the acts for building a new Shirehall 1783 and for building a new Gaol and House of Correction 1786.

<sup>277</sup> Shropshire Archives, Ref: 6001/4848, *Catalogue of books and prints at Boreatton, 1812*.

deposition by his son not to disperse the collection, which is appended to the probate inventory. The presence of, albeit a small quantity of, modern texts on philosophy, science and agriculture is an indication of at least an open-minded attitude to current thinking in matters of improvement. Telford's observations on the primary motivation for building the canal remain the clearest indication that such sentiments prevailed. For those who retained financial investment in the canal company it proved to be largely altruistic, for although its shares retained a tradable value, it did not pay any dividends to shareholders.<sup>278</sup> However, by 1813 its debts had been repaid and promoters were not encumbered with meeting the cost of outstanding debts.

### **3.4.2 'Improvement' and the Ellesmere Canal**

Techniques utilised in the construction of canals and their constituent parts were still in their formative stage in the last quarter of the eighteenth century but innovation and 'improvement' is conspicuous on the Ellesmere Canal. Not all of the improvements described in the following section originated with the builders of this canal. The recognition of their 'fitness for purpose' in the context of the canal and the willingness to adopt and to adapt, demonstrates the desire by engineers and masons to find solutions to impediments, thereby furthering the cause of 'improvement.' Together they attest to the existence of a 'culture of improvement' among a section of the community. The hollow spandrels employed in the aqueduct at Chirk are an example of an adopted technique: the earliest successful utilisation being by John Smeaton (1724-1792) on the Perth Bridge, completed in 1771.<sup>279</sup> The spandrels are the area on a bridge or aqueduct between an arch, the deck and the upright piers or abutments and in arched masonry constructions were traditionally solid stone.<sup>280</sup> The creation

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<sup>278</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969), p. 187.

<sup>279</sup> Engineering timelines <http://engineering-timelines.mig.com/>, Accessed 27<sup>th</sup> March 2013.

<sup>280</sup> [www.merriam-webster.com](http://www.merriam-webster.com)

of voids within the spandrels was a device to reduce weight, as a means of enhancing structural stability or to save costs.<sup>281</sup> Earlier designs, of the 1730s to 1760s, had incorporated earth, rubble or gravel within the spandrels to achieve the requisite saving but were frequently ineffective in ensuring structural integrity. Smeaton's design at Perth had involved the incorporation of parallel longitudinal walls within the spandrels, with the enclosed spaces left empty, thereby achieving structural stability and weight reduction. At Chirk and Pontcysyllte the carriage of structural weight at a substantial height was a major consideration and undoubtedly occupied the thoughts of Telford, Jessop and their team. In February 1796 Telford wrote to Matthew Davidson the superintendent of construction: 'Since leaving Mr Jessop I have been recollecting that in the case of Brick Arches that the Spandrels must be brought up solid.'<sup>282</sup> That was a misunderstanding that was remedied in the fullness of time. A masonry bridge built at Ashford Carbonel in South Shropshire in 1795-7 by William Atkins, has longitudinal internal walls and its design is credited to Telford.<sup>283</sup> Neither his Montford Bridge in 1790-2 nor the Bewdley Bridge, completed in 1798, however, had hollow spandrels and his practical experience in the field at this time was clearly not extensive.<sup>284</sup> Later masonry bridges and aqueducts designed by Telford, such as the Avon Aqueduct on the Edinburgh and Glasgow Union Canal (1819-1821), do have internal longitudinal walls.<sup>285</sup> What is not reflected in narratives of the construction of the Ellesmere aqueducts is that Jessop was apprenticed to Smeaton and then served as his assistant from 1767-1772, covering the period when Perth Bridge was being designed and built.<sup>286</sup> He would therefore have been aware of the design implications associated with that bridge. The rationale for a decision

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<sup>281</sup> Ruddock, E. C., 'Hollow spandrels in arch bridges: a historical study,' in *The Structural Engineer*, Vol.52 (1974), 8, pp. 281-293, 289.

<sup>282</sup> Ironbridge Gorge Museum Library, Ref: DMD8- Acc No 1992.14918, *Matthew Davidson Correspondence, Copy letter book 1795-1818 (136 letters)*, *Thomas Telford to Matthew Davidson, 15 February 1796*.

<sup>283</sup> Ruddock, E. C., 'Hollow spandrels in arch bridges: a historical study,' in *The Structural Engineer*, Vol.52 (1974), 8, p. 290.

<sup>284</sup> Ruddock, E. C., 'Hollow spandrels in arch bridges: a historical study,' in *The Structural Engineer*, Vol.52 (1974), 8, p. 290.

<sup>285</sup> [www.engineering-timelines.com](http://www.engineering-timelines.com) (funded by Institution of Civil Engineers).

<sup>286</sup> Buchanan, R. A., 'Jessop, William (1746-1814)', *Oxford Dictionary of National Biography* (Oxford, 2004); online edn, Oct 2005 [<http://www.oxforddnb.com/view/article/37604>, accessed 6 April 2012]

taken in February 1796 to revert from iron back to masonry arches on the Chirk aqueduct has not been established, but it had major implications given the increase in weight and the planned height of the channel above the river.<sup>287</sup> Jessop's influence in its subsequent design changes and completion would therefore have been an important factor. It also reflects the importance to the advancement of knowledge of collaborations of people drawn together from different backgrounds and with varied experience. The merits of the adaptation of existing technology, as in this case, arise from such collaboration. Debate has arisen over the origin or conceptualisation of a number of the designs employed on the Canal project but that they arose out of the close association of the engineers, masons and ironmasters engaged in aspects of the construction is equally significant in determination of the existence of a Shropshire Enlightenment.<sup>288</sup>

The concept of carrying the Ellesmere Canal across the Dee Valley by aqueduct was ambitious from the outset; Jessop's earliest design, contemplating a height from river level of one hundred and twenty five feet, had not previously been achieved on a navigable waterway. The utilisation of an iron water trough at Pontcysyllte made that possible because of the consequential reduction in weight and increased stability that it afforded. The trough and other elements associated with the construction of the aqueduct advanced the boundaries of technical knowledge. It also tied the activities of the canal builders to those of the Shropshire ironmasters, in particular the experimental testing of iron for use as a structural material. The first detailed plan for the river crossing, produced for the committee in September 1793, was based on a triple-arched masonry aqueduct.<sup>289</sup> A series of locks on either side of the Dee Valley were incorporated, to bring the canal down to the level at which it would cross the

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<sup>287</sup> The total height of Chirk Aqueduct was 70 feet above the Ceiriog River.

<sup>288</sup> Hadfield, C., *Thomas Telford's Temptation: Telford and William Jessop's Reputation* (Shropshire, 1993) regarding the decision to use an iron trough at Pontcysyllte and hollow piers.

<sup>289</sup> This was drawn by Shropshire engineer, William Turner see Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969), p. 170

river on the aqueduct. Having been appointed in October 1793 as agent, surveyor, engineer, architect and overlooker of works, Telford was instructed to complete detailed drawings for approval by Jessop, which were endorsed by the committee in March 1794.<sup>290</sup> As referred to above, in the spring of 1795 experiments on the strength of iron as a structural material were conducted at Ketley and Coalbrookdale ironworks, almost certainly precipitating the move by engineers to adopt its use in bridges and aqueducts and later multi-storey buildings.<sup>291</sup> They lead to enhancement in knowledge across a broad sector, and as will be seen in Chapter 4, to the development of systems of measurement of the tensile strength of iron used in structural engineering. It offers a clear example of how infrastructure developments were being fueled by advances in knowledge.

In July 1795 Jessop, as principal engineer, recommended to the committee the substitution of an iron aqueduct for masonry at Pontcysyllte.<sup>292</sup> Of growing concern had been the loss of water to the canal system precipitated by the operation of locks at the crossing. Consequently the revised aqueduct would be constructed at the full height of the canal, that is, one hundred and twenty five feet above the river, thereby obviating the need for locks.<sup>293</sup> Hadfield raised the issue of whether the decision to switch to use of iron and the design of the aqueduct, rested with Telford, as his autobiography indicates.<sup>294</sup> Jessop had greater experience as a structural engineer than Telford and was also a partner at Butterley ironworks and would have practical knowledge of cast iron not necessarily afforded to Telford. He also had the opportunity of input from his partner, Benjamin Outram and Robert Fulton both of whom were engaged with Jessop in the construction of Peak Forest Canal and the Marple viaduct. In comparison Telford's appointment as engineer on the Shrewsbury Canal on 28<sup>th</sup> February

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<sup>290</sup> British Waterways Museum; *Ellesmere Canal Committee Minute Book*, 23 September 1793 and 31 March 1794.

<sup>291</sup> See above p. 63.

<sup>292</sup> Shropshire Archives, 6000/15025, *Ellesmere Canal- Copy of Wm Jessop's Report*, 6 July 1795.

<sup>293</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 171.

<sup>294</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 172, Telford, T., (ed. J. Rickman), *The life of Thomas Telford*, (London, 1838),

1795 was to be his first practical involvement in canal building and the structural use of iron. That appointment, however, brought him a shared responsibility, with William Reynolds, for the design of the Longdon-on-Tern aqueduct and the completion of the canal. Given his association with Reynolds he was probably party to the Ketley and Coalbrookdale experiments on the strength of iron in March and April 1795 or appraised of the implications of their results in their discussions on the Longdon aqueduct. The issue of Telford's capability to judge the properties of iron and its suitability for utilisation in construction, at this time, must be considered in another light. In April 1795, not only did Telford, as county surveyor, submit a plan to the justices for an iron bridge at Buildwas but twenty-nine foot beams, generally accepted by historians to be for that bridge, were tested at Coalbrookdale.<sup>295</sup> The timing of the two events suggests that both Telford and the Coalbrookdale Company had responded with remarkable speed and competence, even acknowledging the importance of replacing a bridge previously destroyed in the February 1795 floods. William Reynolds and John Wilkinson were asked to review the bridge design on behalf of the county justices and their affirming comments testify to the confidence held in Telford's ability to design and build in a variety of materials.<sup>296</sup> Ultimately the origination of innovations and aspects of improvement is of secondary importance. The perception of the dynamic prevailing in infrastructure development at this time is reinforced by the course of events referred to here: namely that it was largely instituted by collaboration and the diffusion of knowledge. It is a subject that will be elaborated upon in the following section.

The commitment to the use of iron in the construction of the Longdon aqueduct has been held to be a determining factor in the decision to proceed with its incorporation in other

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<sup>295</sup> Lawson, J. B., 'Thomas Telford in Shrewsbury: The metamorphosis of an architect into a civil engineer,' in Penfold, A., (ed.), *Thomas Telford: Engineer* (London, 1980). p. 15.

<sup>296</sup> Shropshire Archives, DP212, *Bridges-various: papers arising from Sessions proceedings*.

structures.<sup>297</sup> Trinder considers, however, that ‘there were few practical lessons to be learned at Longdon,’ particularly in respect of Pontcysyllte, given the timing of the Ellesmere Canal committee’s decision to proceed with an iron trough.<sup>298</sup> However, decisions were clearly taken upon the utilisation of iron for the aqueducts at Pontcysyllte and Chirk, and also for the Marple and Holmes aqueducts in Derbyshire, on the basis of theoretical evaluation rather than the outcome of construction at Longdon. It should be noted, however, that the final design of the trough at Pontcysyllte was not undertaken until 1801, which afforded plenty of time to make value judgements concerning Longdon.<sup>299</sup> In fact change was occasioned at Chirk in February 1796 with the switch back from iron to masonry, as highlighted above. A feature that was significant and arose from Longdon was the design of the plates utilised in the trough. In July 1795, and therefore before the 10 August meeting of the Ellesmere committee meeting to approve adoption of the iron trough, Reynolds produced flanged-plates in cast-iron designed for Longdon.<sup>300</sup> The utilisation of such plates at Pontcysyllte offered greater stability and watertight sealing was effected by a mixture of white lead, flannel and iron borings. The consequent elimination of the need for a lining of puddling clay was a significant contribution to the reduction of weight.<sup>301</sup>

A visit made to the Ketley foundry at this time by Outram and Fulton is claimed by Davidson to have satisfied them as to the suitability of iron for the formation of the trough of an aqueduct, although there is no statement of the source; presumably it being the engineers’ subsequent recommendation of iron aqueducts for utilisation at Marple and Holmes.<sup>302</sup> The significance of the use of iron at Longdon lay in the design of its trough and cruciform

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<sup>297</sup> Particularly Pontcysyllte and Chirk on the Ellesmere Canal, Holmes on the Derby Canal and Marple on the Peak Forest Canal.

<sup>298</sup> Trinder, B., *The Industrial Revolution in Shropshire* (Chichester, 3<sup>rd</sup> ed. 2000), p. 110.

<sup>299</sup> Hadfield, C., *Thomas Telford's Temptation: Telford and William Jessop's Reputation* (Shropshire, 1993), p. 151.

<sup>300</sup> Hadfield, C., *Thomas Telford's Temptation: Telford and William Jessop's Reputation* (Shropshire, 1993), p. 92; Davidson, I., in Cohen, P., ‘Origins of the Pont Cysyllte Aqueduct,’ *Transactions of the Newcomen Society*, Vol 51 (1978-9), p. 141;

<sup>301</sup> Royal Commission on the Ancient and Historical Monuments of Wales, <http://www.rcahmw.gov.uk>.

<sup>302</sup> Davidson, I., in Cohen, P., ‘Origins of the Pont Cysyllte Aqueduct,’ *Transactions of the Newcomen Society*, Vol. 51 1979-80, p. 141.

supporting struts which informed understanding of the structural characteristics of iron for usage beyond the confines of infrastructure.<sup>303</sup> The decision for its utilisation at Pontcysyllte drew upon the momentum. As Trinder declares, it did not inspire the construction of great numbers of aqueducts, but it affirmed the place of iron as a structural component, particularly in structures of magnitude, as the engineers of the nineteenth-century were to demonstrate.<sup>304</sup> In its application at Pontcysyllte, iron afforded a solution for the high-level carriage of the canal but techniques needed to be employed that could deliver the trough to the appropriate height. Determining the means of construction of those elements of the aqueduct employed the combined knowledge and skills of the men involved. Their identification and the manner of their undertaking are relevant to the appreciation of innovation and enlightened activity at this time within the region and form the subject of the following paragraphs.

Recent work by the Royal Commission on the Ancient and Historical Monuments of Wales has given an indication of the manner and sequence in which construction of Pontcysyllte was effected.<sup>305</sup> Physical evidence shows that beams, supporting working platforms, were erected between pairs of piers and were raised as the height of the piers progressed. From seventy feet above river-level the eighteen piers were built hollow with internal bracing for added strength, which reduced loads on the foundations compared to solid masonry.<sup>306</sup> The RCAHMW study determines that the hollow piers also improved safety for the workers, allowing them to climb the inside of the pier from the seventy feet level utilising the cross-bracing. The safety of the workforce was of importance to the engineers as Jessop and Telford indicate.<sup>307</sup> There is no indication of how access to the hollow portion would be gained and a hole in the pier may

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<sup>303</sup> Trinder, B., *The Industrial Revolution in Shropshire* (Chichester, 3<sup>rd</sup> ed. 2000), p. 111

<sup>304</sup> Trinder, B., *The Industrial Revolution in Shropshire* (Chichester, 3<sup>rd</sup> ed. 2000), p. 110.

<sup>305</sup> In future RCAHMW; <http://www.rcahmw.gov.uk>.

<sup>306</sup> Shropshire Archives, Ref: 6000/15037, *Report to the General Committee of the proprietors of the Ellesmere Canal Company, 24 January 1800*.

<sup>307</sup> Telford, T. in Plymley, J., *A General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1803), p. 308; Ironbridge Gorge Museum Library, DMD8-1992.14918, *Matthew Davidson Correspondence, Copy letter book 1795-1818, Jessop to Telford, 26 July 1795*; Shropshire Archives, Ref: 6000/15037- *Report to the General Committee of the Proprietors of the Ellesmere Canal Company by Wm Jessop 24th January 1800*

have been left to effect entry. The piers were also tapered from the bottom in both dimensions to reduce weight and enhance stability. They measured 20' by 12' at the base, narrowing to 13' by 7' 6" at the top.<sup>308</sup> The tapered piers gave the edifice an elegance that sat well with prevailing expressions of the aesthetic ideal. The quality of their construction caused Jessop to record that the columns: 'were executed in a more masterly manner than anything of the kind that I have before seen.'<sup>309</sup> The mason responsible for the work was John Simpson (1755-1815), an important contributor to the group working on projects with Telford and who was engaged in a great deal of building work in the county towards the end of the eighteenth century. Telford recalled: 'John Simpson is a treasure of talents and integrity...I met him here by chance, employed and recommended him, and now he has all of the work of any magnitude in this great and rich district.'<sup>310</sup>

The issue of weight was an abiding factor in the construction of both aqueducts, for although reverting to a masonry construction at Chirk, the base of the trough was ultimately made of cast iron plates secured to the masonry side walls.<sup>311</sup> Hadfield suggests a lack of certainty on the part of Jessop and Telford at the prospect of an iron trough of such length, may have contributed to the change of mind.<sup>312</sup> It seems more likely that the failure in 1792 and 1793 of two aqueducts constructed by Jessop on the Cromford Canal made them cautious, particularly in the light of their functioning at the forefront of technical understanding. Telford's report on Chirk of November 1801 records: 'By this mode of construction, a very considerable proportion of the masonry is saved in the breadth of the Aqueduct; the risque (sic) of expansion or contraction from puddling is avoided.'<sup>313</sup> At Pontcysyllte the trough and hollow

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<sup>308</sup> Hadfield, C. And Skempton, A. W., *William Jessop, Engineer*, (Newton Abbot, 1979), p. 151.

<sup>309</sup> Shropshire Archives, Ref: 6000/15037, *Report to the General Committee of the proprietors of the Ellesmere Canal Company, 24 January 1800*.

<sup>310</sup> Telford to Little, 8 Dec 1798 in Gibbs, A., *The story of Telford*, London, 1835.

<sup>311</sup> Shropshire Archives, Ref: 6000/15057, Telford, T., *Report to the Committee of the Ellesmere Canal*, 25 November 1801.

<sup>312</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969.), p. 173.

<sup>313</sup> Shropshire Archives, Ref: 6000/15057, Telford, T., *Report to the Committee of the Ellesmere Canal*, 25 November 1801.

spandrels afforded by the use of iron supporting ribs also contributed to the reduction of overall weight and a greater stability furnished to the edifice (see Image 3/5).

**Image: 3/5**



**Spandrels on the Pontcysyllte Aqueduct- Photograph by Roger Bruton**

Amongst other features in the construction of the Ellesmere Canal, the southern embankment at Pontcysyllte was 1,500 feet in length and claimed to be the largest earth embankment in Europe at the time. It was constructed by engineer William Davies under the supervision of Telford. Along with William Hazeldine and John Simpson, Davies was also a contractor for the construction of the Chirk Aqueduct. The towpath on Pontcysyllte trough was a further innovative feature. Where that at Longdon-on-Tern was formed by a small supplementary

trough at the side of the main channel, Pontcysyllte's pathway over hangs the eastern edge of waterway allowing water to flow beneath it.<sup>314</sup> Davidson reflects on the movement of water in the trough making reference to Bernoulli's Theorem in fluid dynamics, published in 1738.

The additional width of trough allows the wash from the boat to dissipate and not be lost over the side and he suggests that a prior knowledge of hydraulic flow implicit in its application in the construction of Pontcysyllte, 'would constitute an elegant example of the art of the engineer.'<sup>315</sup> Both Jessop and Telford were well-read and may have been aware of the practical implications of the theorem but there is no documentary evidence of its application.

The design of the towpath, however, mirrors that applied at the Berwick Tunnel on the Shrewsbury Canal, in that the water was allowed to flow beneath the towpath. Although Telford had been engineer to the canal, which opened in 1797, William Reynolds had suggested the inclusion of the path through the Berwick tunnel and may therefore have influenced the design. Telford's position as engineer on both canals, however, clearly determined the creation of towpaths for the Chirk and Whitehouses tunnels on the Ellesmere Canal and they became the first incorporated on mainline canal tunnels.

The construction of the canal and its distinguishing features represent the application of ingenuity and as far as it can be considered to demonstrate facets of Enlightenment behaviour it reveals that, in Shropshire, it was not limited to the advancement of industrialisation. The case study also confirms that infrastructure improvements are not dependent upon intellectual advances. The adoption of techniques to accommodate the specific conditions presented by the Ellesmere Canal, such as hollow spandrels and the application of Bernoulli's Theorem, attest to a creativity of thought employed by its initiators. As important as the innovations to

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<sup>314</sup> Royal Commission on the Ancient and Historical Monuments of Wales, [Http://www.rcahmw.gov.uk](http://www.rcahmw.gov.uk).

<sup>315</sup> Davidson, I., in Cohen, P., 'Origins of the Pont Cysyllte Aqueduct,' *Transactions of the Newcomen Society*, Vol. 51 1979-80, p. 141.

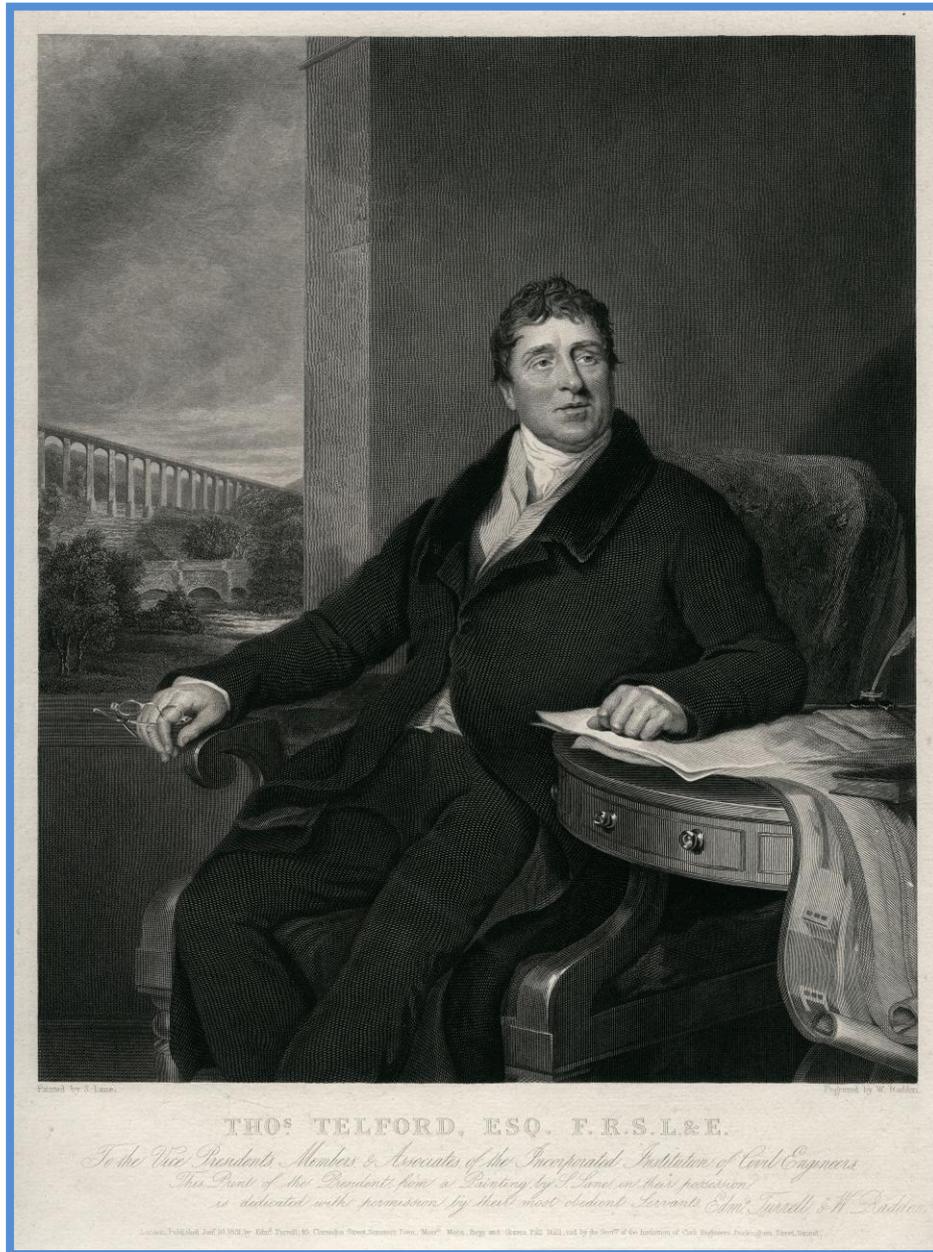
be found on the Ellesmere Canal, was the association of individuals: the intellectual community.

### **3.4.3 The Ellesmere intellectual community**

In his oration on the opening of Pontcysyllte in November 1805, Rowland Hunt paid tribute to individuals who brought their knowledge and skills to an undertaking which in his opinion served the cause of economic gain and would benefit the wider population. Expressions of enlightened belief on the part of promoters have been discussed but the furtherance of knowledge and its dissemination lies in the activities of those who constructed the canal and its monumental structures. One of the questions that this study has endeavoured to ascertain is the extent to which associational behaviour in Shropshire and its region at this time promoted or added to intellectual development. The construction of the Ellesmere Canal offers a perspective on the workings of one such network. As principal engineer to the project William Jessop bore primary responsibility for its completion, although Telford's name is justifiably associated with it. Telford's pride in Pontcysyllte is marked by his choice of the aqueduct as back drop for the portrait painted by Samuel Lane which hangs in the Institution of Civil Engineers (see Image 3/6). In 1793 Jessop was one of the foremost civil engineers in the country and as highlighted in the example of the Perth Bridge, he brought a level of knowledge and experience to the project that at this time was not shared by Telford. That Telford would come to overshadow Jessop as one of the greatest British civil engineers was the result of a sharp intellect, creativity and the ability to utilise knowledge absorbed from a variety of sources. Katherine Plymley's 1796 diary entry, recording that Telford was 'an

excellent architect and a most intelligent and enlightened man' proved to be very perceptive.<sup>316</sup>

Image: 3/6



Portrait of Thomas Telford by Samuel Lane with permission of the National Portrait Gallery

<sup>316</sup> Shropshire Archives, 1066/20, *Journals of Catherine Plymley*, 5 Nov 1793; Lawson, J. B., 'Thomas Telford in Shrewsbury: The metamorphosis of an architect into a civil engineer,' Penfold, A.,(ed.), *Thomas Telford, engineer* (Ironbridge, 1979), p. 2.,

The need for collaboration was frequently enforced by an individual's contracts of engagement. Telford, for example, was required to seek Jessop's sanction for changes to agreed plans and designs. Telford refers to consultations between himself and Jessop in correspondence with Matthew Davidson, the Inspector of Works at Pontcysyllte and for the Llanymynerch line: '...if you think of any other matter that requires his advice be so good as write me from time to time and every day if necessary when he and I have such a favourable opportunity of consulting together.'<sup>317</sup> The nature of the relationships amongst this group of master craftsmen does not, however, seem to be conditioned entirely by hierarchical accountability. An exchange of knowledge, experience and opinion endured amongst men who were pushing the boundaries of civil engineering. Whilst Jessop was one of the country's foremost civil engineers and had responsibility for reporting to the Ellesmere Canal committee, there is a sense of collegiality in the resolution of issues and removal of impediments to the progress of the project. Telford forwarded to Jessop considerations of a revision to the structure of Chirk aqueduct, undoubtedly previously discussed by himself and other members of the team:

I have seen Mr Jessop as to the Aqueduct at Chirk, and he agrees as to the general principle of the adopting Brick or Rubble Arches instead of an Iron Trough, only he thinks that the Piers should be set out as to allow 6 feet instead of 5 feet on each side of the Canal- the distance between the Piers to be 45 feet, or if it would not increase the expense very much, say 40 feet as John Simpson thinks that 45 feet is a great deal for Brick Arches...Mr Jessop wishes you to consider whether inverted Brick Arches laid upon Flannel would not answer and be much cheaper than the stone Bottom...<sup>318</sup>

The importance of the opinions of such as Simpson and Davidson are demonstrated in the letter: particularly noteworthy in the case of the mason, John Simpson, given that Telford himself was a time-served mason. In addition to the principal engineers, Telford and Jessop,

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<sup>317</sup> Ironbridge Gorge Museum Library, Ref: 1992.14918, *Telford to Matthew Davidson, 25 February 1796.*

<sup>318</sup> Ironbridge Gorge Museum Library, Ref: 1992.14918, *Telford to Matthew Davidson, 15 February 1796.*

the craftsmen who represented the nucleus of the intellectual community functioning around the Ellesmere Canal, were: John Simpson, Matthew Davidson, William Davies and William Hazeldine. The group were to work together in a number of combinations subsequent to their involvement with the Ellesmere Canal and it was often their reputation that recommended them.<sup>319</sup> A Scot, John Simpson had been engaged by the architect George Steuart to supervise the construction of his new Saint Chad's church in Shrewsbury.<sup>320</sup> William Hazeldine was another contractor at St Chad's, which was possibly where they first became acquainted. In addition to St Saint Chad's and the Ellesmere Canal the two men were engaged in work on Ditherington Flax Mill, Vrynwy Aqueduct, Caledonian Canal and Bonar Bridge in Scotland, amongst others. Upon Simpson's death in 1815, Matthew Davidson wrote to his son: 'I mourn him deeply.'<sup>321</sup> Davidson had known Telford when both were stonemasons in Langholm, Dumfries and his appointment as Inspector of Works no doubt arose from Telford's enduring wish to engage people in key roles that he could trust. His earliest presence in Shropshire can be identified in 1790 on the Montford Bridge construction, the first undertaken by Telford.<sup>322</sup> He was also employed subsequently as one of the superintendents of construction on the Caledonian Canal project. Davidson held strong views on the issue of self-improvement as witnessed in correspondence to his son, Thomas.<sup>323</sup>

William Davies had responsibility for major earthworks on the Canal including the massive Southern Embankment and cuttings and the Chirk and Whitehouses tunnels.<sup>324</sup> Whilst little is known of Davies other than his involvement with Pontcysyllte, Hazeldine went on to become

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<sup>319</sup> For example, Scottish Record Office, *Telford to John Rickman, 27 September 1803*, in Hadfield, C., and Skempton, A. W., *William Jessop, Engineer* (Newton Abbot, 1979), p. 156.

<sup>320</sup> Owen, H. & Blakeway, J.B., *A history of Shrewsbury* (London, 1825). Ref: Ref: rqDA690.S58H6.

<sup>321</sup> Ironbridge Gorge Museum Library, *Matthew Davidson to Thomas Davidson, 24 August 1815*, Ref: 1992.14919.

<sup>322</sup> Shrewsbury Archives, DP 113, *Accounts re Montford Bridge*.

<sup>323</sup> Ironbridge Gorge Museum Library, *Matthew Davidson to Thomas Davidson, 21 February 1813*, Ref: 1992.14919; See quotation in Chapter 6, p.209.

<sup>324</sup> Hunt, R. 'Report to the General assembly of the Ellesmere Canal Proprietors held at the Royal Oak Inn, Ellesmere on 27<sup>th</sup> day of November 1805 to which is annexed, The Oration, delivered at Pontcysyllte Aqueduct on its first opening, November 26 1805', Ironbridge Gorge Museum Library.

mayor of Shrewsbury in 1836, displaying a taste for radical politics.<sup>325</sup> Trained as a millwright he established himself as an ironmaster in Shrewsbury and he supplied ironwork for many of Telford's constructions, including the major bridges of Conway, Menai and Bonar. Telford undoubtedly felt that the knowledge and originality of thought Hazeldine brought to the construction projects they undertook to be significant. In correspondence he referred to Hazeldine as 'the arch-conjuror himself Merlin Hazeldine.'<sup>326</sup> The atmosphere in which this group functioned clearly enhanced mutual intellectual stimulation. As mentioned a number of the contractors progressed to undertaking civil engineering construction in their own right, without Telford's direct involvement and Davidson's expression of belief in the acquisition of knowledge was mirrored also by Telford and Hazeldine. The latter's probate inventory includes self-improving texts and Telford was described as an avid reader by Smiles.<sup>327</sup> Lesser lights engaged in the Ellesmere Canal construction were also subsequently employed on the Caledonian Canal: John Wilson, James Cargill and John Telford afford clear examples of the itinerant artisans referred to elsewhere in this thesis, who disseminated developed knowledge as they relocated.<sup>328</sup> The extent to which the relocation of this 'customary affiliation' of craftsmen and artisans from one contract to another, represented a new manifestation of labour organisation, remains an area for further research. The engagement of established teams upon major works offering the prospect of significant challenges, lay in the expectation that they would be competently addressed. The identification of named artisans who made such transition adds to the understanding of the dynamics and organisation of such projects.

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<sup>325</sup> Pattison, A., *William Hazeldine, Shropshire Ironmaster and Millwright: A reconstruction of his life, and his contribution to the development of engineering, 1780-1840*, Unpublished M. Phil Thesis, 2011, University of Birmingham, pp. 127, 137 .

<sup>326</sup> Ironbridge Gorge Museum Library, Ref: 1992.14918, *Telford to Matthew Davidson, 19 February 1796*.

<sup>327</sup> Pattison, A., *William Hazeldine, Shropshire Ironmaster and Millwright: A reconstruction of his life, and his contribution to the development of engineering, 1780-1840*, Unpublished M. Phil Thesis, 2011, University of Birmingham, pp. 127, 137; Smiles, S., *Lives of the Engineers*, (London, 1861).

<sup>328</sup> Penfold, A., 'Managerial organisation on the Caledonian Canal,' p.136 in Penfold, A., (ed.), *Thomas Telford: Engineer* (London, 1980), Hadfield, C., and Skempton, A. W., *William Jessop, Engineer* (Newton Abbot, 1979), p. 161.

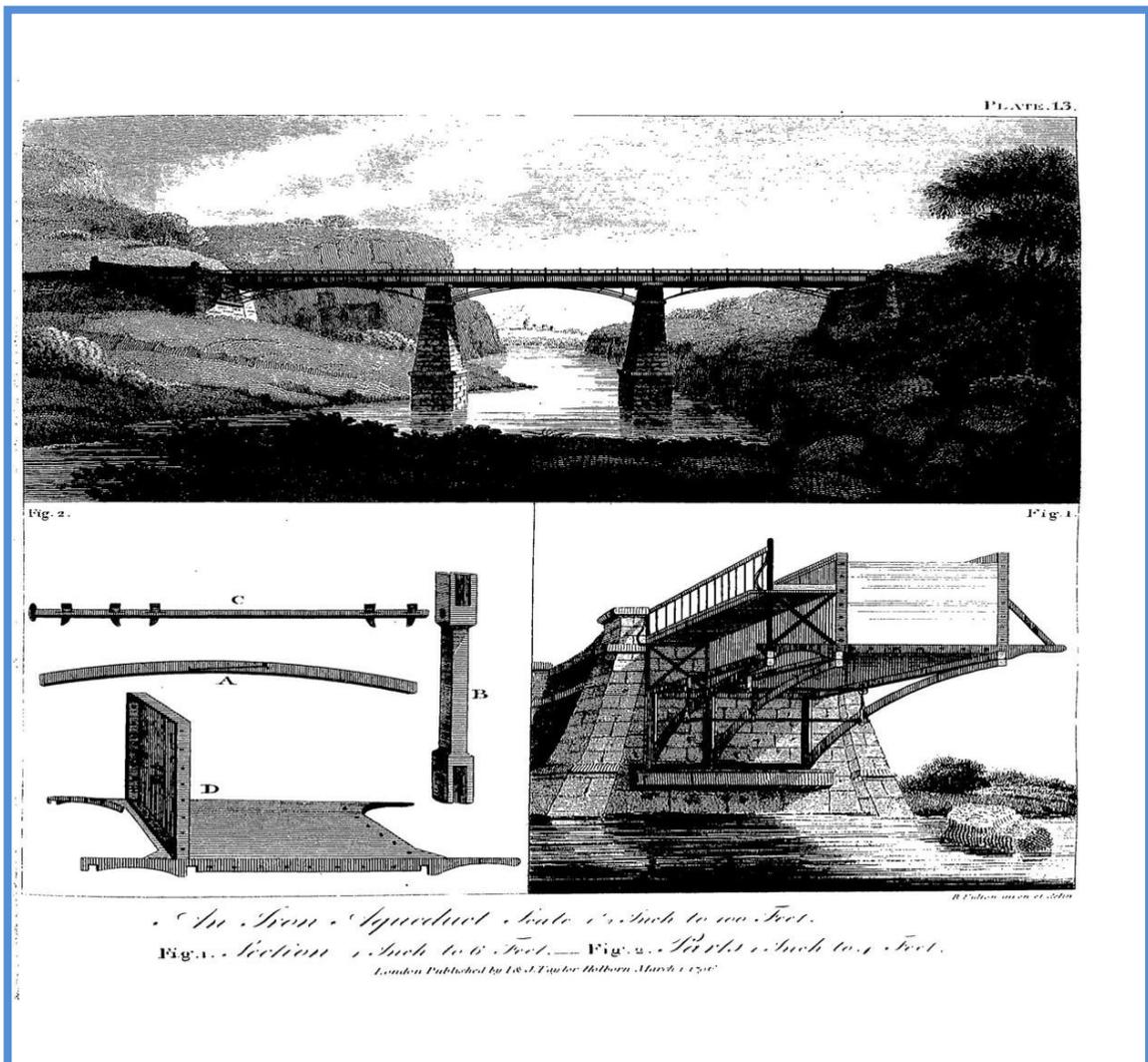
Attention has already been drawn to the influence of those visitors to Shropshire engaged purposefully in the exchange of knowledge. As principal engineer Jessop was not only informing and instructing the team involved in the Ellesmere Canal, as Telford's letter of 15 February 1796 demonstrates, but furthering his own knowledge in what was an evolving science. Outram and Fulton undoubtedly contributed to the intellectual flow that existed amongst the Ellesmere contractors and Shropshire ironmasters, as opposed to merely securing information from them, as Telford claims in his section on canals in Plymley's *General View*.<sup>329</sup> Telford's charge against Fulton was centred on the latter seeking credit for concepts that Telford asserted had originated in Shropshire. Fulton, however, gave fulsome praise to William Reynolds for development of the canal-inclined plane which seems to be the area of concern for Telford. In March 1796 Fulton published a treatise on canals that contained a plan of an aqueduct with tapered masonry piers, arched iron ribs and an iron trough which bears similarities in appearance to Pontcysyllte (see Image 3/7).<sup>330</sup> There are significant differences in the two designs, particularly with regard to the respective troughs, but considering the drawing pre-dates all but the laying of the foundation stone at Pontcysyllte it adds to the uncertainty over the derivation of innovations. References to tapered piers at Pontcysyllte are first noted in Jessop's Report of 24 January 1800. It should be noted, however, that iron ribs were a feature of Telford's design of 1795 for the Buildwas bridge. As a member of this intellectual community Jessop was contributing to the debates, designs and ideas associated with the project and inevitably acting as a conduit with Fulton and Outram, with whom he also closely worked. Attempts at attribution are therefore compromised but do not unduly detract from evaluation of enlightenment behaviour within the Shropshire locale.

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<sup>329</sup> Plymley, J., *A General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1803), p. 308.

<sup>330</sup> Fulton, R., *A Treatise of the improvement of Canal Navigation exhibiting the numerous advantages to be derived from Small Canals...* (London, 1796).

Image: 3/7



An etching by Robert Fulton from *A treatise on the improvement of canal navigation*

### 3.4.4 Conclusion

At 126 feet above the river, Pontcysyllte was the highest navigable aqueduct in the world at the time of its completion and its construction represented groundbreaking use of cast iron.

Trinder's view that Pontcysyllte did not lead to major developments in aqueducts elsewhere is valid but that cannot be laid at the feet of the men who conceived and constructed the

edifice.<sup>331</sup> They resolved problems by innovation and application of established techniques in a new and challenging environment; above all by collaboration. The experience and knowledge gained by Jessop, Telford and their colleagues transferred to subsequent projects, thereby furthering the cause of improvement. Weight and its distribution were critical factors in the development of structures and iron offered a solution: but it relied on the evolution of methods to enable its utilisation. The innovations arose from conceptualisation by individuals frequently working in concert and the transformation into reality by the skills of craftsmen. Whether such processes can be married to Mokyr's conception of an Industrial Enlightenment must, however, be in doubt. He maintains that 'transportation benefited from the expansion of useful knowledge like few other industries,' and although Shropshire industrialists were slow to adopt canals as a means of advancing economic growth, the Ellesmere Canal and tub boat canals demonstrated how the application of knowledge could further that end.<sup>332</sup> For a time Shropshire was a nodal point for knowledge generation and dissemination and the civil engineers were part of the community that contributed to the advancement of knowledge. Among the declared aims of the promoters of the Ellesmere Canal was the enhancement of the cause of agriculture and its associated benefit for the population as a whole. In a similar vein was the expectation that it would be advantageous to the industries of the borderland. The curtailing of the initial planned route through to Shrewsbury thwarted those expectations to a degree. The connection with the Montgomeryshire and Chester Canals and the construction of rail roads to the mines and ironworks around Plas Kynaston and Bersham, however, produced satisfactory resolution of the ambitions.<sup>333</sup> In terms of the lines of enquiry that the study seeks to address, the chapter and case-study identifies the means employed in the furtherance of improvement through collaboration and transfer of knowledge. It also

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<sup>331</sup> Trinder, B., *The Industrial Revolution in Shropshire* (Chichester, 3<sup>rd</sup> ed. 2000), p. 110.

<sup>332</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009), p. 155.

<sup>333</sup> Hadfield, C., *The Canals of the West Midlands* (Newton Abbot, 2<sup>nd</sup> ed. 1969), p. 170.

draws attention to improvement that was occasioned by intellectual advance. In other cases the adoption of existing methodologies were employed in new environments. Through a small collection of letters the case-study also indicates the manner in which the dissemination of knowledge was sustained.

## Chapter 4: The Industrial Dimension of Intellectual Activity

### 4.1 Introduction

Innovation and the role of its ironmasters characterise much of Shropshire's history.<sup>334</sup> The manifestations of that innovation; the acquisition, utilisation and dissemination of knowledge form the subject of the chapter. The influence of networks and associational activity that determined those advances are also examined. The Enlightenment notion of economic advancement as a 'progressive and reforming force,' is implicit in this evaluation.<sup>335</sup> Joel Mokyr's concept of an 'Industrial Enlightenment' is also measured against manifestations of intellectual activity in late eighteenth and early nineteenth century Shropshire.<sup>336</sup>

A small number of industrial figures dominate this historical landscape as a consequence of the nature of their enterprise and the range and scope of their interests. The pioneering activities of the ironmasters John Wilkinson (1728-1808), William Reynolds (1758-1803) and the father and son Abraham Darby II and III (1711-1763 and 1750-1789) will be explored. But the determination of a Shropshire Enlightenment based on the activities of such a few men is restrictive and references are made to 'lesser lights' who broaden the perspective and timeframe. Charles Woolley Bage's principal claim to distinction is as the designer of Ditherington Flax Mill, recognised since 1950 as the world's first multi-storey iron-framed building.<sup>337</sup> A case study on Bage and Ditherington offers the opportunity to examine the dynamic of knowledge acquisition and the functioning of contemporary networks.

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<sup>334</sup> For example Raistrick, A., *Dynasty of ironfounders* (London, 1953); Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000); Mokyr, J., *The gifts of Athena*, (Princeton, 2002).

<sup>335</sup> Kramnick, I. *The Portable Enlightenment Reader*, London, 1995, x.

<sup>336</sup> Mokyr, J., *The gifts of Athena*, (Princeton, 2002).

<sup>337</sup> Bannister, T., 'The first iron-framed buildings,' *Architectural Review*, CVII (1950), pp. 231-246; Skempton, A.W. and Johnson, H.R., 'The first iron frames,' *Architectural Review*, (1962), pp. 175-186; Trinder, B., 'Ditherington Flax Mill, Shrewsbury- a re-evaluation,' *Textile History*, 23 (2) (1992), pp. 189-223.

The nature and extent of artisan activity in the generation of useful knowledge and the progression of economic change in the eighteenth century is frequently obscured by the shortage of extant contemporary testimony. A number of historians have placed importance on the contribution of artisans across Europe.<sup>338</sup> Liliane Hilaire-Perez draws attention to the initiation of innovation arising from the developing technical culture employed amongst such groups and the knowledge resource which they could access or to which they could contribute.<sup>339</sup> It was a process encouraged by growing migration of artisans and consequential transfer of technical and methodological knowledge. It influences much of the contemporary evolution of Shropshire industry and is addressed in terms of the Shropshire wrought-iron trade by Richard Hayman.<sup>340</sup> Above all else, characteristics that define the emergence of English Enlightenment are identifiable in the development of Shropshire businesses, the contributions of its industrialists, engineers and artisans and the creation and adoption of technological advances. As previously highlighted, the industries most associated with Enlightenment Shropshire involve iron and the associated extractive industries and as a consequence the major focus of attention in this chapter falls upon those sectors of local economic activity. As Mokyr acknowledges, the relationship between science and mechanics in the late eighteenth and early nineteenth centuries is extensive but recognised as being variable across industries and products. It is a proposition that warrants extension to incorporate localities, timeframes and the variability of the utilisation of useful knowledge across the spectrum of industrial activity.<sup>341</sup> There are, however, several noteworthy references to its application in an economic context arising from other trades, for example

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<sup>338</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009), p. 116; Hilaire-Perez, L., 'Technology as a public culture in the eighteenth century: the artisans legacy,' in *History of science*, 45, 2007, p. 137; Berg, M., 'The genesis of useful knowledge', *History of science*, xlv, 2007, p. 129.

<sup>339</sup> Hilaire-Perez, L., 'Technology as a public culture in the eighteenth century: the artisans legacy,' in *History of science*, 45, 2007, p. 137.

<sup>340</sup> Hilaire-Perez, L., 'Technology as a public culture in the eighteenth century: the artisans legacy,' in *History of science*, 45, 2007, p. 137; Hayman, R., 'The Shropshire Wrought-Iron Industry, c1600-1900: a study of technological change', unpublished PhD thesis (University of Birmingham, 2003).

<sup>341</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009), p. 140.

associated with the construction of Ditherington Flax Mill in Shrewsbury and railway engines at Coalbrookdale and Bridgnorth.

#### **4.2 Shropshire Industrialists and Technological Advance**

Hayman argues that modern studies of the history of the iron industry have moved from being centred upon key technological changes to recognition of the influence of social, economic and political factors. This echoes the approach of this study but the identification of the scope and impact of such innovation places these factors in context.<sup>342</sup> As reflected in Chapter 3 developing transferability and accessibility of knowledge was of primary importance to the initiation of sustainable industrial progress. Hilaire-Perez encapsulates the position: ‘Several historians have shown that, in workshops, in yards and in factories, the ability to project and to invent was fostered by collective capacities to gather knowledge, to compare, to substitute, and to imitate in order to adapt products to markets, to opportunities and to constraints.’<sup>343</sup>

Chronologically the initial focus of this study on innovation in Shropshire rests on the second Abraham Darby (1711-1763) and his experimentation with coked coal as blast-furnace fuel for the production of iron suitable for forging. However a tradition of innovation already existed in Shropshire and the East Shropshire Coalfield. The landmark achievement of Darby’s father, Abraham I (1678-1717) in 1708 in accomplishing sustainable production utilising iron smelted with coal, was highly significant in early-stage industrialisation in that it demonstrated firstly that it could be done and that it produced iron that was fit for the purpose for which it was required, that is casting. But it was a process that did not spread beyond Shropshire and there is no evidence that his methodology ultimately facilitated further advances in iron technology. It is as likely that his son, Abraham II, revisited the issue of

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<sup>342</sup> Hayman, R., 'The Shropshire Wrought-Iron Industry, c1600-1900: a study of technological change', unpublished PhD thesis (University of Birmingham, 2003), p.4

<sup>343</sup> Hilaire-Perez, L., 'Technology as a public culture in the eighteenth century: the artisans legacy,' in *History of science*, 45, 2007, p. 136.

utilising coal in his furnace in order to produce a quality of iron capable of being converted into malleable iron rather than attempt to convert his father's process. Whilst Abraham I's method was progressive in terms of being the result of advanced thinking it is difficult to make an argument for it to be considered a stage in the establishment of an Enlightenment movement. It appears to be a purely commercial venture; may not be seen to be necessarily for the greater good; and probably did not lead directly to further improvement. Peter King has suggested that Shadrach Fox may have pre-dated Darby in achieving the smelting of iron with coal at Coalbrookdale, in 1690s, but on the evidence presented it appears not to have been a sustainable method.<sup>344</sup>

At the time of the second Darby's accession to the management of Coalbrookdale in 1745, the business was centred upon the provision of cast-iron domestic products, parts for atmospheric steam engines and cannon.<sup>345</sup> The Swedish traveller Reinhold Angerstein on his visit to Coalbrookdale in 1754, comments on the unsuitability of local iron for wrought-iron, the growing market for which may have persuaded Darby to reconsider the casting process employed in the foundry.<sup>346</sup> In parts of England in the 1750s charcoal was ten to fifteen times more expensive than in Sweden and fuel costs for 'fining' iron in England with mineral coal were six shillings per ton of iron compared to three pounds fifteen shillings with charcoal.<sup>347</sup> In the introduction to Angerstein's travel diary, however, Marilyn Palmer comments on the output from the Willey and Leighton furnaces, also owned by the Coalbrookdale partnership but utilising charcoal fuel, as being fifty percent greater than the sister foundry, which is surprising given that furnaces were generally able to bear a higher charge of raw materials

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<sup>344</sup> King, P.W., 2003, *The iron trade in England and Wales, 1500-1815; the charcoal iron industry and its transition to coke*, Unpublished thesis, University of Wolverhampton, 2003, p. 52.

<sup>345</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed. 2000), pp. 26-27

<sup>346</sup> Angerstein, R. R., *R.R. Angerstein's travel diary, 1753-1755: Industry in England and Wales from a Swedish perspective* (London, 2001), pp.329.

<sup>347</sup> Palmer, M., 'Introduction' in Angerstein, R. R., *R.R. Angerstein's travel diary, 1753-1755: Industry in England and Wales from a Swedish perspective* (London, 2001), pp.vxii, 329.

utilising coke than with charcoal, structural constraints of the furnace excepted.<sup>348</sup> Darby's motivation for improvements therefore may have been driven by both demand and supply-side pressures; the demand for greater quantities of wrought iron and the need to reduce unit product costs and establish reliability of supply of raw materials. In the latter respect the increasing difficulty in securing timely supplies of charcoal, due to timber shortage, were a persistent concern for iron-makers. Consequently economic necessity may be the decisive influence in Darby's search for revised methods.

The assertion by Labouchere that the determination of new processes within iron-founding was propelled in some way by deeply-held religious conviction that successful outcomes would be for the ultimate benefit of mankind, may reflect the views of some contemporary Quakers, but in practice, such benefit may have been entirely incidental.<sup>349</sup> The moral essence of such belief is compromised, however, by the participation of a number of the Quaker families, such as the Goldneys of Bristol and Galtons of Birmingham, in addition to the Darbys, in the production and distribution of weaponry.<sup>350</sup> However, Darby's success in securing improvement in iron-founding helped remove process constraints and advanced the progress of Industrial Revolution irrespective of any supplementary personal motives.<sup>351</sup> His widow, Abiah, wrote of her husband's refusal to accede to the entreaty of his friend, the ironmaster Edmund Knight, to patent the process, expressing the desire to make the knowledge available to all. During his period of managerial control over the Coalbrookdale works he wrought changes in the operations of the company that ensured its establishment as

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<sup>348</sup> Angerstein, R. R., *R.R. Angerstein's travel diary, 1753-1755: Industry in England and Wales from a Swedish perspective* (London, 2001), pp.329.

<sup>349</sup> Labouchere, R., *Abiah Darby, 1716-1793, of Coalbrookdale, Wife of Abraham Darby II* (York, 1988), p.39;

<sup>350</sup> Morgan, Kenneth, 'Goldney, Thomas (1696–1768)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edn, May 2009 [<http://www.oxforddnb.com/view/article/56846>]; Smith, Harry, 'Galton, Samuel (1753–1832)', *Oxford Dictionary of National Biography*, Oxford University Press, Sept 2013, <http://www.oxforddnb.com/view/article/105102>; Trinder, B., *The Darbys of Coalbrookdale*, Phillimore (London, 1981), p. 26.

<sup>351</sup> Letter by Abiah, widow of Abraham Darby II cited in Raistrick, A., *Dynasty of ironfounders* (London, 1953), p 68 and Trinder, B., *The Darbys of Coalbrookdale*, Phillimore (London, 1981) p. 27.

the foremost iron-making concern in the country.<sup>352</sup> Enlarged furnaces were constructed; steam engines applied to the return of water for the furnace blast; bellows improved; railway systems were enhanced and extended; leases over substantial areas of land were entered into in order to bring raw material supplies largely under their own control and establish a form of vertical integration.<sup>353</sup> Trinder comments that much of the development by Abraham Darby II was based on acquired knowledge rather than original thought, but all the same it represented a programme of ongoing improvement that was to remain influential across the region and beyond, through much of the third quarter of the eighteenth century.<sup>354</sup>

Following the death of Abraham Darby II in 1763 the momentum for change and improvement in an industrial context was picked up by the next generation of innovators. Amongst the most prominent was Darby's nephew William Reynolds (1758-1803). Well-respected amongst his contemporaries for his intelligence and great competence, Reynolds had spent time studying under Joseph Black (1728-1799), James Watt's friend and sometime collaborator at Glasgow University. He was to maintain an interest in the relationship between science and manufacturing.<sup>355</sup> Richard Crawshay (1739-1810) the Cyfarthfa ironmaster described Reynolds as 'having more metalurgie and chemical skil (sic) than any other of my friends.'<sup>356</sup> That interest in the industrial potential of chemistry manifested itself in his involvement in the creation of a business near Wombridge for the production of sulphuric acid and later sodium carbonate and in plans, established in conjunction with Lord Dundonald, for a chemical plant associated with the production of 'alkali' at Coalport.<sup>357</sup>

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<sup>352</sup> Raistrick, A., *Dynasty of ironfounders* (London, 1953), p. 69; Ince, L., *The Knight family and the British iron making history*, Birmingham, 1991), p37; Trinder, B., *The Darbys of Coalbrookdale*, Phillimore (London, 1981), p. 32.

<sup>353</sup> Ince, L., *The Knight family and the British iron making history*, (Birmingham, 1991), p.70; Trinder, B., *The Darbys of Coalbrookdale*, Phillimore (London, 1981), p 32.

<sup>354</sup> Trinder, B., *The Darbys of Coalbrookdale*, Phillimore (London, 1981), p 32.

<sup>355</sup> Ironbridge Gorge Museum Library, Transcription of Samuel More's Journal, 1780, p.23 (original journal page 100); Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p. 106; Raistrick, A., *Dynasty of ironfounders* (London, 1953), p. 92.

<sup>356</sup> Letter Richard Crawshay to William Reynolds, 4<sup>th</sup> August 1790 in Evans, C., *The letterbook of Richard Crawshay, 1788-1797* (Cardiff, calendared 1990), p70; Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000),p. 106.

<sup>357</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p. 94-95.

Reynolds laid down infrastructure at Coalport to encourage new business enterprises, in some of which he had a financial interest. Joseph Plymley (1759-1838) was provoked to comment that “Coalport...established by the genius and laudatory exertions of Mr William Reynolds, bids fair to rival Stourport.”<sup>358</sup> His interests in science went beyond mechanics and chemistry. As discussed in Chapter 6, the study of mineralogy and fossils were an abiding passion and his collection was a source of empathy with friends and visitors. Reynolds contributed informed opinions to the published works of others but for a business owner heavily involved with the extractive industries, knowledge of geological structure and its implications to that business was a positive benefit.<sup>359</sup>

During the period in which Reynolds was running Ketley ironworks it was one of the largest in the country and retained a reputation for innovation.<sup>360</sup> He constantly sought to improve or adopt new methodologies in iron production, puddling and steel manufacture, and to understand the characteristics of iron with regard to its utilisation as a structural material.<sup>361</sup> In 1799 he secured a patent (No 2363) for the manufacture of manganese steel.<sup>362</sup> Tests conducted at Ketley and Coalbrookdale in 1795 on the load-bearing capabilities and tensile strength of iron were a formative factor in the establishment of procedures governing its utilisation in building and infrastructure projects by architects and structural engineers for a

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<sup>358</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p. 87-91; Plymley, J., *A General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1803), p 342.

<sup>359</sup> Townson, R., 1799, 'A sketch of the mineralogy of Shropshire' in *Tracts and Observations in Natural History and Physiology* (London, 1799), pp. 158-203; Plymley, J., *General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1803); A letter from Thomas Beddoes, MD to Sir Joseph Banks, Bart, P.R.S., 'Further observations on the process for converting cast iron into malleable iron,' in *Philosophical Transactions of the Royal Society of London, Part II* (London, 1792), pp. 257-269, Read May 3 1792; see Torrens, H. C., The Reynolds-Anstice Shropshire geological collection, 1776-1981, 'Archives of Natural History', (1982), 10 (3), pp. 429-441.

<sup>360</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed. 2000), p. 78.

<sup>361</sup> Raistrick, A., *Dynasty of ironfounders* (London, 1953), p. 211; Letter Richard Crawshay to William Reynolds, 4<sup>th</sup> August 1790 in Evans, C., *The letterbook of Richard Crawshay, 1788-1797* (Cardiff, calendared 1990), p. 70; Trinder, B., 'William Reynolds: Polymath- A biographical strand through the Industrial Revolution,' *Industrial Archaeological Review*, XXX:1, (2008), pp. 17-32.

<sup>362</sup> Shropshire Archives, Ref C20, Patent 2363, 1799, Prosser, R, Superintendent of Examiners at the Patent Office, 'A list of patents granted under the old law 1617-1852 to persons resident in Shropshire,'.

quarter of a century.<sup>363</sup> Reference was made in the previous chapter to his involvement in the development of canals and railways in Shropshire and he designed and introduced inclined planes for the transfer of boats between levels. The development and application of steam engine technology was an abiding interest for Reynolds and he recognised at an early age the potential it afforded for industrial progress.<sup>364</sup>

At the age of nineteen Reynolds negotiated with Watt for the installation of engines at Ketley ironworks, following the successful installation of the latter's engines at Bloomfield Colliery, Tipton and Wilkinson's New Willey ironworks in 1775 and 1776. In the 1780s he was installing rotative engines and discussing with Watt the use of engines to provide 'direct blast' to the furnaces rather than by way of the intermediate step of pumping water to a waterwheel. By the 1790s Reynolds was seeking modifications of engines to operate winding gear at coal mines, the subsequent installation of which represented a major improvement in the coal industry.<sup>365</sup> Examples of the letters between Reynolds and Watt in the Archives of Soho, attest to their mutually respectful relationship, even at the point when Reynolds was accommodating other engine designers at Ketley, much to Watt's irritation. In 1783 Reynolds expressed the hope of seeing Watt at his home at Bank House and in 1795 Watt invited Reynolds to call upon him to discuss science, a subject of great interest to them both: "I am glad to hear that I have at last got a fellow labourer in the pneumaticle (sic) vineyard."<sup>366</sup>

Whilst Reynolds pursued engineering challenges as a means to an economic end, the extent to which they also represented intellectual pursuits is less easy to determine. However, a group of innovative engineers, undoubtedly influenced by the reputation of the Ketley ironworks as

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<sup>363</sup> Banks, J., *On the power of machines, etc* (London, 1803); Lawson, J. B., 'Thomas Telford in Shrewsbury: The metamorphosis of an architect into a civil engineer.' pp. 17, Penfold, A., (ed.), *Thomas Telford: Engineer* (London, 1980).

<sup>364</sup> Ironbridge Gorge Museum Library, 'Transcription of Samuel More's Journal, 1780', p. 23(original journal p. 100).

<sup>365</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), pp. 51-2.

<sup>366</sup> Archives of Soho, Birmingham Archives and Heritage, Ref: MS3219/4/124/218, Letter Wm. Reynolds to J. Watt- 5 June 1783, Ref: MS 3147/3/381/55; James Watt to William Reynolds- 25 Dec 1795,.

‘a centre of excellence,’ were drawn to work in collaboration with Reynolds: there were others who graduated from Ketley.<sup>367</sup> Richard Trevithick (1771-1833), Jonathan Hornblower (1753-1815), John Urpeth Rastrick (1780-1856), Adam Heslop, James Glazebrook and James Sadler (1753-1828) were all involved in the development of steam engine technology. Reynold’s Sketch Book contains one hundred and twenty-eight sketches, engravings and water colours of machines or engineering solutions.<sup>368</sup> Some are of his own design, others by collaborators such as Sadler and Hornblower, or are items that are of interest to him and that he has in other ways obtained. There are several marked as being produced by or bearing a contribution by the Spanish engineer Agustin de Betancourt (1758-1824) and one from the visit of the American civil engineer Robert Fulton (1765-1815) in 1796, all of which reflect the extent of contact associated with knowledge exchange and the pursuit of improvement at the end of the eighteenth-century. In parts of Continental Europe Betancourt was a formative influence on the development of mechanical engineering in the late eighteenth and early nineteenth centuries but was described by Matthew Boulton as a thief.<sup>369</sup> The origination of Watt’s ‘double-acting’ engine had been claimed by De Prony in France supposedly from information obtained by Betancourt during a visit to England. He toured Europe extensively for the enhancement of his own knowledge but also for the benefit of those who would pay him for it.<sup>370</sup> Having been attracted to Russia in 1808 he also founded the first school of

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<sup>367</sup> Raistrick, A., *Dynasty of ironfounders* (London, 1953), p. 156; Trinder, B., ‘William Reynolds: Polymath- A biographical strand through the Industrial Revolution,’ *Industrial Archaeological Review*, XXX:1, (2008), p. 22 .

<sup>368</sup> ‘An 18<sup>th</sup> Century Engineer’s Sketch Book,’ is housed at the Science Museum, Kensington, London and an index of the contents produced by the museum and included in Dickinson, H. W., ‘An Engineer’s sketch book of the 18th Century,’ *Transactions of the Newcomen Society*, Vol. 2, 1921-2, pp. 132-9. Its usefulness in the context of this study is further explored in the section on dissemination of knowledge.

<sup>369</sup> Payen, J., *Capital et machine à vapeur au XVIIIe siècle: les frères Pérrier et l’introduction en France de la machine à vapeur de Watt* (Paris, 1969); Robinson, E. H., ‘The early diffusion of steam power,’ *The Journal of Economic History*, vol. 34, No 1, the tasks of economic history (Mar 1974), pp. 91-107, p. 95; Egovert, O. V., ‘A mystery of one Havana portrait: the first steam engine in Cuba,’ *History of machines for heritage and engineering development* (2011, Netherlands); Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009), p. 159;

<sup>370</sup> ‘El informe de d. Agustin de Betancourt y la red de carreteras en 1802,’ [online], available from: <http://trid.trb.org/> [accessed 5 Dec 2012]; Villar-Ribera, R., Hernandez-Abad, F., Rojas-Sola, J., Hernandez-Diaz, D., ‘Agustin de Betancourt’s telegraph: study and virtual reconstruction, in *Mechanism and Machine theory*, Vol. 46, issue 6, June 2011, pp. 820-830.

advanced engineering in Russia.<sup>371</sup> He was clearly a man of ability and someone that Reynolds was prepared to engage with, in the mutual exchange of knowledge.

Dickinson's article on the sketch book indicates that this collection originally represented a portion of a much larger archive and it conveys a structured approach to Reynolds thinking. He retained drawings that he had completed or commissioned, possibly as a form of reference, particularly as they are supplemented by the work of others that was probably admired or felt may be useful. They can be seen to be adding to the reservoir of useful knowledge upon which he can draw. Trinder reflects that William Reynolds had 'no special claim to celebrity' in terms of innovations he produced, but his observation is measured against the view that Reynolds was the most intellectually able of all Shropshire ironmasters given his sustained interest in science and its application to industrial processes.<sup>372</sup> He displayed a personal dynamism in respect of the level of activity in which he was engaged, the recognition of business opportunities and expansion of his business interests. The pursuit of improvement and the identification of the potential for innovation led him to encourage and financially support new ideas, and was drawn from a scientific education and continuing interest in natural philosophy. It led him to become one of the most significant industrialists in the region in the late eighteenth-century. The Shropshire-born doctor, Thomas Beddoes (1760-1808), commented to Joseph Banks, president of the Royal Society, of how Reynolds' 'enterprising spirit and inventive genius have improved our machinery, enlarged our manufactures, and changed the face of a large district in his native county.'<sup>373</sup>

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<sup>371</sup> Egovera, O. V., 'A mystery of one Havana portrait: the first steam engine in Cuba,' *History of machines for heritage and engineering development* (2011, Netherlands), [online], available from <http://link-Springer.com>, [accessed 5 Dec 2012].

<sup>372</sup> Trinder, B., 'William Reynolds: Polymath- A biographical strand through the Industrial Revolution,' *Industrial Archaeological Review*, XXX: 1, (2008), p. 17.

<sup>373</sup> Beddoes, T., 'Further observations on the process for converting cast into malleable iron.' *Philosophical Transactions of the Royal Society of London*, vol82, 1792, p. 268.

A close collaborator of Reynolds with whom he pursued his interest in the industrial potential of chemistry, was Archibald Cochrane, ninth Earl of Dundonald (1749-1831). He brought his skills and imagination to Shropshire undoubtedly because of his perception of the business opportunities that existed within the region, and maintained a residence in the Severn Gorge for thirteen years until 1800. A scientist by inclination and businessman by financial necessity he was a pioneer in a chemical industry that was very much in its infancy. Being heavily encumbered by inherited debt he sought resolution of those problems by the conversion of acquired knowledge to industrial production, much of which arose from extensive experimentation. He joined in the fervour to discover an affordable substitute for seaweed, or barilla, in the production of sodium carbonate and potassium carbonate, used in industrial processes such as glass and soap making, bleach and dyestuffs.<sup>374</sup> Not having capital to undertake such projects on his own account he was forced to attract partners or underwriters to his ventures, or to sign away his rights in a business scheme for licence or royalty payments.

In the early 1790s, before his removal to Shropshire, he had established businesses in Carlisle and Newcastle with a group of partners for the production of soda from salt, in both cases having to subsequently surrender his share of the companies. A theme that characterised many of Dundonald's projections involved integrated manufacturing and the utilisation of by-products of processes, whereby the waste from one process becomes the raw material for another. Such was his proposal to William Reynolds with regard to the creation of a joint-venture at Coalport in 1799 for the production of 'alkali.'<sup>375</sup> He conceived that the location of each stage in a manufacturing sequence would be in proximity to one another, the logistics

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<sup>374</sup> Sugden, J., 'Archibald, 9th Earl of Dundonald: An Eighteenth-century Entrepreneur,' *Scottish Economic and Social History*, Vol. 8, 1988, p. 16-18;

<sup>375</sup> Clow, A and N., *The Chemical Revolution*, (London 1952), pp. 620-639; Letters Dundonald to Wm Reynolds December 1799, ScRO GD233/106/C/60, 106/C/7/1 cited in Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed. 2000), p. 95

and cost of transfer of by-products being thereby greatly reduced. Dundonald's enduring commercial interest revolved around tar, either from natural resources or from the distillation of coal and he had previously established tar-kilns on his estate at Culross, Perthshire. The process of distillation produced coke for iron-making; pitch, used as a sealant for ships and buildings; and oil, which was condensed into a varnish.<sup>376</sup> From the mid-1780s he was discussing with the Shropshire ironmasters the establishment of tar-kilns. William Reynolds had previously installed kilns at Madeley Wood, presumably because of the proximity of the natural tar spring but he was to add kilns designed by Dundonald and in 1789 to build more at Ketley. Dundonald added others to the nearby Benthall furnaces.

The Swede, Eric Svedenstierna noted that at Calcutts ironworks, owned by Alexander Brodie, 'they had made attachments to the twenty furnaces according to Lord Dundonald's invention, in order to collect bituminous parts of the coal when it is turned to coke.'<sup>377</sup> Hebert's *Encyclopedia* (1836) records Dundonald's process and that, 'One of these tar-works...was erected at Mr Wilkinson's great works at Bradley, another at Tipton and a third at the Level Colliery and Iron works upon Dudley-wood.'<sup>378</sup> The perpetuation of the commercial pursuit of such goals was undoubtedly a factor in Dundonald's thinking in his proposals to Reynolds concerning the Coalport chemical factory and which were confounded by the latter's untimely death in 1803. By the time of Dundonald's own death in 1831 he had ten patents to his name and amongst all of the Shropshire industrialists of the eighteenth-century was the most

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<sup>376</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed. 2000), p.93

<sup>377</sup> Trinder, B., 'William Reynolds: Polymath- A biographical strand through the Industrial Revolution,' *Industrial Archaeological Review*, XXX:1, (2008), p. 22; Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p. 93; Sugden, J., 'Archibald, 9th Earl of Dundonald: An Eighteenth-century Entrepreneur,' *Scottish Economic and Social History*, Vol. 8, 1988, 15; Svedenstierna, E. T., *Svedenstierna's tour: Great Britain, 1802-3: the travel diary of an industrial spy*, (translated from German by E. L. Dellow), (Newton Abbot, 1973), p. 66-7;

<sup>378</sup> University of Birmingham Cadbury Library; Sellbourne Coll TJ9, Hebert, L., *Engineer's and Mechanic's Encyclopedia, comprehending practical illustrations of the machinery and processes employed in every description of manufacture of the British Empire*, (London, 1836) p. 754.

published.<sup>379</sup> A friend of Reynolds, the Cyfarthfa ironmaster Richard Crawshay, referred to one of Dundonald's publications as an 'ingenious manuscript on iron.'<sup>380</sup> Dundonald had a very enquiring mind and epitomised the Enlightenment concept of improvement in the pursuit of advancement of knowledge. His work on coal tar distillation and alkali opened the doors for major industrial developments in industrial chemistry in the nineteenth century despite his own failure as a businessman.

Someone who was not a failure in business was John Wilkinson (1728-1808). He had business establishments located in Staffordshire, Shropshire, Denbighshire and Anglesey, but his home and the base of his operations for thirty years was in Broseley, Shropshire. With a reputation as an uncompromising competitor he exhibited a drive for improvement in business that was based on innovation and the recognition of opportunities, to which the geographical span of his empire gives testimony. When his opportunism extended to disregard of patent constraints on Boulton and Watt engines, however, it led to threats of litigation in 1796 between the Soho partners and their major supplier. From the outset Wilkinson was an important contributor to the establishment of Boulton and Watt's steam engines, to the point of being considered worthy of a partnership.<sup>381</sup> Prior to the launch of Watt's 'fire engine with separate condenser' Wilkinson had proved his ability to supply cast cylinders to a consistently higher degree of accuracy than had been the case with the previous supplier, Carron Ironworks. In 1774 he had secured a patent for his 'new method of casting and boring guns and cannons,' by means of rotating the casting rather than the boring tool, a process which he subsequently modified for the production of engine cylinders. It proved to be a defining

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<sup>379</sup> Amongst his treatises were: *Thoughts on the manufacture and trade in salt* (nd); *The present state of the manufacture of salt explained* (1784); *A treatise shewing the intimate connection that subsists between agriculture and chemistry*; 1785); *Account of the qualities and uses of coal tar and coal varnish* (London, 1785). *Letters from the earl of Dundonald on making bread from potatoes* (1791). The treatise on the connection between agriculture and chemistry is considered more fully in the following chapter on Agricultural Improvement.

<sup>380</sup> Letter 240 R. Crawshay to J. Cockshutt 11 Aug 1790, Evans, C., *The letterbook of Richard Crawshay, 1788-1797* (Cardiff, calendared 1990).

<sup>381</sup> Randall, J., (1917 reprint), *Our coal and iron industries and the men who have wrought in connection with them. The Wilkinsons; with portrait of John Wilkinson, "The father of the iron trade," and descriptions of the first iron vessel and the first iron bridge...*(Madeley, 1876, reprint 1917), p21, Letter James Watt to Matthew Boulton, 8<sup>th</sup> July 1778, in Dawson, *John Wilkinson*, p. 67.

moment for the success of the new engine. Watt wrote to the engineer John Smeaton: ‘Mr Wilkinson has improved the art of boring cylinders so that I promise a 72 inch cylinder being not further from absolute truth than the thickness of a thin sixpence in the worst part.’<sup>382</sup> The patent was, however, revoked in 1779, judged by the Board of Trade to be too similar to that introduced at Woolwich Arsenal by Dutchman Jan Verbruggen.<sup>383</sup> Given that Wilkinson was a friend of Samuel More, the Secretary of the Society of Arts, it seems unlikely that he was not aware of Verbruggen’s machine but is indicative of Wilkinson’s tunnel vision when it came to the pursuit of improvement. Considered in conjunction with the breach of Watt’s engine patent it seems that other people’s patents were an inconvenience when greater rewards were at stake. The modification of his original design for the purpose of producing cylinders had not, however, been patented by Wilkinson and others such as the Coalbrookdale works and Jonathan Hornblower were to introduce similar machines for boring engine cylinders much to Wilkinson’s chagrin.

Wilkinson was frequently engaged in testing Watt’s new designs, assessing where modifications were necessary and even promoting his own conceptions of alternative applications for the engines, particularly as a source of power for driving machinery. The rotative process introduced by Watt in 1782 expanded further the potential for engine usage in industry. Wilkinson employed it to power the forge hammers at his Bradley ironworks, a process that became a favoured method of forging iron in the industry for many years.<sup>384</sup> On a visit to Bersham his friend Samuel More recorded in his journal:

Peace now being restored the Gun Trade which used to supply so much business at these works is now stopt (sic) the Employment therefore is not so brisk as it used to be but my industrious and ingenious friend (Wilkinson) whose thoughts are ever

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<sup>382</sup> James Watt to John Smeaton, 1776, cited in Rolt, L.T.C., *Tools for the job: a history of machine tools to 1950*, (London, 1986) p. 56.

<sup>383</sup> Rolt, L.T.C., *Tools for the job: a history of machine tools to 1950*, (London, 1986) pp. 53-56, 56.

<sup>384</sup> Dickinson, H.W., *John Wilkinson, ironmaster, 1728-1808* (Ulveston, 1914), pp. 20, 30.

employed and whose Purse is ever open to the Encrease (sic) of this Manufacture is busied now in erecting machines for making Bar Iron with Coak from Coak Pigs.<sup>385</sup>

In 1790 he secured a patent for 'a new method of making lead pipes and in 1792 he devised and patented a revised form of rolling mill.<sup>386</sup> He experimented with the application of 'hot-blast' to his furnaces twenty-seven years before Neilson patented his method and with the rifling of gun barrels, demonstrating his capacity for innovation.<sup>387</sup> In 1787 an iron boat reputedly capable of carrying in excess of thirty two tons was launched at Willey, having been built for Wilkinson by John Jones of Lincoln. It was conceived, according to Randall, as a means of shipping his manufactured armaments down the Severn to Gloucester or Bristol.<sup>388</sup> At this time Watt had high regard for Wilkinson's abilities as he confirmed in a letter to his cousin, which outlined his plans for sending son James junior to study at Bersham for a year, views undoubtedly later tempered by the emergence of knowledge of Wilkinson's systematic breach of Watt's patents.<sup>389</sup> Wilkinson's attention to detail and refinements to processes and design, borne of close study and a drive for improvement, mark him as an Enlightenment man.

The origins of advancement in industrial processes frequently entailed collaboration and the pooling of knowledge, of both masters and men, but the potential value of artisans are often only visible when they established themselves in positions of authority or in their own businesses. John Urpeth Rastrick (1780-1856) was to become one of the country's leading railway engineers in the second quarter of the nineteenth century but spent formative years at the beginning of the century in the hothouse environment that prevailed at Ketley under the

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<sup>385</sup> Transcription of Samuel More's Journal,' Ironbridge Gorge Museum Library, p. 7(original journal p. 30)

<sup>386</sup> Dickinson, H. W., *John Wilkinson, ironmaster, 1728-1808* (Ulveston, 1914), p.31;

<sup>387</sup> Dickinson, H. W., *John Wilkinson, ironmaster, 1728-1808* (Ulveston, 1914), p.30, 33.

<sup>388</sup> *Gentleman's Magazine*, vol. 57 (1787), p 732; Randall, J., (1917 reprint),*Our coal and iron industries and the men who have wrought in connection with them. The Wilkinsons; with portrait of John Wilkinson, "The father of the iron trade," and descriptions of the first iron vessel and the first iron bridge...*(Madeley, 1876, reprint 1917), p. 17.

<sup>389</sup> Birmingham Archives and Heritage, Archive of Soho, James Watt to Mary Campbell 30 May 1784, 3219/4/123/103.

management of William Reynolds.<sup>390</sup> Following apprenticeship in his father's engineering business in Northumberland where he had worked on the construction of steam engines, he may have been attracted to working with the engine designer Richard Trevithick. The Cornishman had first worked in Shropshire in 1796, and in 1802 plans and trials of high-pressure steam engines were being conducted at Coalbrookdale.<sup>391</sup> Alternatively Rastrick may have been drawn by the reputation of Ketley for being one of the foremost ironworks in the country. Reynolds himself had allegedly pursued an interest in locomotives and supported Trevithick's trials.<sup>392</sup> In 1804 Coalbrookdale and John Hazeldine's ironworks in Bridgnorth were making their own engines but also engines and components for Trevithick and Rastrick was to develop a long-term friendship with the Cornishman. His subsequent move to a partnership with John Hazeldine around 1807 brought the opportunity to broaden his skills and experience and a developing knowledge of civil engineering techniques led in 1816 to his construction of an iron bridge at Chepstow.<sup>393</sup>

Rastrick's diary from 1811 presents a view of the 'daily round' of the businessman in visiting customers and markets, attempting to re-finance the business, dealing with 'the men,' and, importantly, the dynamics of the innovation process. On the 8 April, he recorded that, whilst travelling, he had been preoccupied with thoughts of designing a rotary engine, without any satisfactory outcome. During the following day ideas crystallized into a workable design and he noted the commitment of the design to paper on the completion of his journey. By 14 April the prospect was established in his mind: 'This morning I compaired (sic) my rotative engine

<sup>390</sup> Peacock, R., (ed.), *James Foster of Stourbridge, 1786-1853: Industrialist and benefactor*, (Kingswinford, 2006), p. 23; Boase, G. C., 'Rastrick, John Urpeth (1780-1856)', rev. M. W. Kirby, *Oxford Dictionary of National Biography*, (Oxford, 2004); online edn, Jan 2008 [<http://www.oxforddnb.com/view/article/23153>, accessed 4 Oct 2012].

<sup>391</sup> Peacock, R., (ed.), *James Foster of Stourbridge, 1786-1853: Industrialist and benefactor*, (Kingswinford, 2006), p. 23; Boase, G. C., 'Rastrick, John Urpeth (1780-1856)', rev. M. W. Kirby, *Oxford Dictionary of National Biography*, (Oxford, 2004); online edn, Jan 2008 [<http://www.oxforddnb.com/view/article/23153>, accessed 4 Oct 2012].; Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p. 107; Burton, A., *Richard Trevithick: Giant of steam* (London, 2000), p. 84.

<sup>392</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p. 107; Burton, A., *Richard Trevithick: Giant of steam* (London, 2000), p. 85; Rastrick, A., *Dynasty of ironfounders* (London, 1953), p159;

<sup>393</sup> Peacock, R., (ed.), *James Foster of Stourbridge, 1786-1853: Industrialist and benefactor*, (Kingswinford, 2006), p. 23; Boase, G. C., 'Rastrick, John Urpeth (1780-1856)', rev. M. W. Kirby, *Oxford Dictionary of National Biography*, (Oxford, 2004); online edn, Jan 2008 [<http://www.oxforddnb.com/view/article/23153>, accessed 4 Oct 2012].;

both with Jonathan Hornblowers (sic) and also with John Cook Esq, Master of the Royal Irish Academy. Find it superior to both... Rest of day considering my rotative motion and sketching etc and drawing a boiler for Morley Park.<sup>394</sup> The process as recorded seems remarkably spontaneous and if put into effect, the design would no doubt be worked up through a range of trials and modifications to its conclusion but these few lines in the diary capture an environment that stimulated original thought and supported the pursuit of its development.

Thomas and George Cranage also feature amongst the few local contemporary artisans to whom a name can be put. They were employed by the Coalbrookdale Company, George as a foreman and Thomas as a manager at the Bridgnorth forge leased by Coalbrookdale. They were perhaps fortunate to work for Richard Reynolds who not only encouraged their trials in refining cast pigs to wrought iron but, on the successful outcome, ensured that the process was patented in their own names.<sup>395</sup> In a letter in April 1766 Reynolds commented: 'I look upon it as one of the most important discoveries ever made and that the resulting iron was the toughest I ever saw.'<sup>396</sup> It was a process that pre-dated the 'puddling method' developed by Henry Cort by seventeen years but the duration of its utilisation was brief due to the apparent inconsistency of output and wasteful use of raw material. Hayman concludes that there was no evolutionary trail in the development of the refining of iron that included the Cranage process.<sup>397</sup> Contemporary forging improvement differed in origination and resolution from that of other industrial applications, in that it depended largely on the skill of the operative and highlights the relevance of the activities of artisans within the scope of this study.<sup>398</sup>

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<sup>394</sup> Shropshire Archives, Ref: MI4329, 'Bridgnorth Diary 1811.'

<sup>395</sup> Hayman, R., *The Shropshire Wrought-iron industry c1600-1900*, Unpublished PhD thesis, University of Birmingham, 2003, p. 11-13, contains an assessment of the importance of the Cranage Bros in the evolution of puddling.

<sup>396</sup> Richard Reynolds letter to Thomas Goldney, Bristol, 25 April 1766 in Raistrick, A. *Dynasty of ironfounders* (London, 1953), p. 85.

<sup>397</sup> Trinder, B., *The Darbys of Coalbrookdale*, Phillimore (London, 1981), p 36; Hayman, R., 'The Shropshire Wrought-Iron Industry, c1600-1900: a study of technological change', Unpublished PhD thesis, University of Birmingham, 2003, p. 91

<sup>398</sup> Hayman, R., 'The Shropshire Wrought-Iron Industry, c1600-1900: a study of technological change', Unpublished PhD thesis, University of Birmingham, 2003, p. 91

These innovations in industrial processes arose throughout the second half of the eighteenth-century but there is no visibly significant industrial innovation originating within Shropshire or amongst its industrialists beyond the first decade of the nineteenth, which raises the issue of whether the dynamic for improvement had changed. From the late 1830s Coalbrookdale became involved in decorative iron work which, whilst it helped to restore the company's fortunes, was neither improving nor enlightened.<sup>399</sup> Richard Hayman reflects that in the Shropshire wrought-iron industry, following the prolonged adoption of puddling, few innovations in forging methods were embraced until 1870s; that is with the exception of the adoption of the process of 'pig-boiling' established by Joseph Hall of Tipton around 1830.<sup>400</sup> Hayman's view is confirmation of an underlying change in the nature of improvement in that industry.<sup>401</sup> His assertion that "by the mid nineteenth-century ironmasters continued to invest technical authority on a core group of skilled men, just as they had done a century earlier," undoubtedly refers to the control of continuing processes as opposed to the endowment of new ones.<sup>402</sup> In his study there is, however, a recognition of the necessity to judge technological change within contexts that are not solely defined by locality but frequently rest on the criteria pertaining to an individual firm. These arise from quite specific commercial determinants, such as the type or quality of the product required for the customer-base. Hayman also suggests that prevailing conditions influenced change, not just the appearance of new technologies: the adoption of coal fuel in forges and new steam-engine technology were accomplished, in his view, because of the existence of established knowledge and experience in those fields that eased the way and as a consequence directly stimulated growth in the

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<sup>399</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p. 107

<sup>400</sup> Hayman, R., 'The Shropshire Wrought-Iron Industry, c1600-1900: a study of technological change', Unpublished PhD thesis, University of Birmingham, 2003, p. 215

<sup>401</sup> Trinder, B., *The Darbys of Coalbrookdale*, Phillimore (London, 1981), p. 117.

<sup>402</sup> Hayman, R., 'The Shropshire Wrought-Iron Industry, c1600-1900: a study of technological change', Unpublished PhD thesis, University of Birmingham, 2003, p. 216.

Shropshire wrought-iron sector in the eighteenth-century.<sup>403</sup> The inference from this is that comparable conditions did not present themselves in the mid nineteenth-century.

In many instances the adoption of change in Shropshire ironworks was spasmodic rather than universal and generally slow to become established. Cort's puddling process was patented in 1783 and 1784 and even demonstrated by him at Ketley in December 1783, but it was around 1796 before evidence indicates that a number of the major ironworks were utilising the process.<sup>404</sup> Such circumstances are, Hayman believes, reflective of the "collaborative culture" that defines forges, their operation and the manual nature of the work involved and makes them distinct from foundry operations or other major industries. As a consequence he places much of the responsibility, or credit, for change on the shoulders of the artisans in this sector of the local economy: on the application of 'trial and error' in the attainment of skills and upon their geographical mobility in the transfer of those skills.

Whilst recognising that in this environment accomplishment of change is inevitably dependent upon the contribution of the artisans employed, there must, in the dynamic of this process be initiation and control of its conduct, and by default that role falls to the manager or owner: to him falls the ultimate determination of its progress. Visibility of knowledge transfer and appreciation of what influence social conditioning such as Enlightenment precepts may bring to bear upon the incidence of change is therefore more frequently afforded by examination of the activities of individuals rather than the totality of collaborative efforts by those artisans engaged in its initiation. The motivational drivers of change initiated by artisanal groups are inevitably diverse, even within discrete groups, and are not necessarily identifiable, due to the invisibility of the individual artisan in the historical narrative. This

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<sup>403</sup> Hayman, R., 'The Shropshire Wrought-Iron Industry, c1600-1900: a study of technological change', Unpublished PhD thesis, University of Birmingham, 2003, p. 215.

<sup>404</sup> Trinder, B., 'William Reynolds: Polymath- A biographical strand through the Industrial Revolution,' *Industrial Archaeological Review*, XXX:1, (2008), p. 20; Hayman, R., 'The Shropshire Wrought-Iron Industry, c1600-1900: a study of technological change', Unpublished PhD thesis, University of Birmingham, 2003, p. 216.

study therefore sets those identifiable actions of the individual in the context of their social and economic influences.

### **4.3 Practical manifestations of an urban science culture**

The view that a science culture prevailed in the major industrial towns and was instrumental in driving innovation and process improvement has wide acceptance amongst historians of science and has been explored extensively with reference to Birmingham, Sheffield, Manchester and other locations.<sup>405</sup> In a study based on textile manufacturers in Leeds, Margaret Jacob examines the relationship between the progress of industrial advancement and both chemical and mechanical sciences. She argues that such a culture conditioned the exploration of improvement in Leeds. By the adaptation of steam power to production processes, local manufacturers grasped the opportunity and by 1824, one hundred and twenty nine steam engines had been installed in the town.<sup>406</sup> Jacob explores the extent to which industrialists understood the technology and science underpinning the improvement they were pursuing. She cites the extant notebooks left by flax spinner, John Marshall and cloth manufacturer, Benjamin Gott, both of whom became very wealthy and progressed to civic leadership in Leeds in the early nineteenth century.

As with elements of Bage's letters to William Strutt which are discussed later, the notebooks recorded stages in an empirical process; they identified what worked, but not necessarily the underlying chemistry or theory conditioning the results. Marshall's notebooks included experiments and trials carried out on steam engines and equipment such as looms, together with his engineer Matthew Murray.<sup>407</sup> He experimented on dyeing and bleaching and other

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<sup>405</sup> For example Hopkins, E., *The rise of the manufacturing town: Birmingham and the Industrial Revolution (1998, Stroud)*; Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009);

<sup>406</sup> Jacob, M.C., 'Mechanical science on the factory floor: the early industrial revolution in Leeds,' in *History of Science*, xlv, 2 (June 2007), p. 202.

<sup>407</sup> Jacob, M.C., 'Mechanical science on the factory floor: the early industrial revolution in Leeds,' in *History of Science*, xlv, 2 (June 2007), p. 210.

chemical processes and gave details of a course of fifteen lectures given in Leeds by John Booth, an itinerant science lecturer. The lectures included much of the normal catalogue of such courses including chemistry, optics, pneumatics, mechanics, electrics and hydrostatics as discussed in greater detail in Chapter 6. Those same notebooks describe investigations of the machinery and processes used in allied industries with a view to developing similar methodologies in flax spinning and weaving. The experiment books on bleaching and dyeing recorded not only his own activities but experiments and observations undertaken by those functioning in the wider public sphere, such as the French chemists, Berthollet and Lavoisier. Gott was similarly engaged in experimentation but predominantly upon the applications for engine technology within his factory. As with leading industrialists in other major industrial towns, both Marshall and Gott achieved civic prominence and promoted the establishment of a literary and philosophical society within Leeds, whilst Matthew Murray established a significant engineering business of his own.<sup>408</sup>

By comparison Elliott's hypothesis on the cultural development of county towns in Georgian England determines that the conditioning influences were largely based upon a diversity of local socio-economic factors and prevailing civic identity.<sup>409</sup> The presence in county towns of higher proportions of professional men servicing the needs of the landed elite and those assembling at what Elliott deems as traditionally the centres of civic governance and commercial enterprise, determined that the character of socio-scientific culture was less utilitarian than industrial towns.<sup>410</sup> That scenario, however, does not fit, either where a county town had a high level of developing industrial enterprise or where substantial commercial activity is established in centres other than the county town. Derby and Nottingham, county

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<sup>408</sup> Jacob, M.C., 'Mechanical science on the factory floor: the early industrial revolution in Leeds,' in *History of Science*, xlv, 2 (June 2007), p. 202.

<sup>409</sup> Elliott, P. A., *Enlightenment, modernity and Science: geographies of scientific culture and improvement in Georgian England* (London, 2010), pp. 167-218.

<sup>410</sup> Elliott, P. A., *Enlightenment, modernity and Science: geographies of scientific culture and improvement in Georgian England* (London, 2010), p. 188.

towns utilised in Elliott's study, fostered active scientific communities along with burgeoning industrial economies and developed utilitarian forms of science culture. In counties such as Warwickshire, Lancashire and Yorkshire, the county towns were not the centres of commercial activity and the provision of services such as banking, commercial law and transport, within those and similarly structured counties, migrated to the major industrial centres. Those centres also evolved a scientific culture defined by the perceived needs and particular interests of their respective citizens. Elliott highlights the scientific culture of Derby and its county, characterised by its topography, natural history and substantial industries in mineral extraction. Many of its industrialists and intellectual elite consequently had interests in geology and botany.<sup>411</sup> Studies of Enlightenment culture in either county or urban settings have to take due account of the defining factors specific to that particular locale. The centre of industrial development that defines Enlightenment-period Shropshire was based neither in its county town nor in any distinct urban location, the nature of its primary industries determining the impracticability of such a circumstance. Although much of that industry was located within the East Shropshire Coalfield, it was a widely dispersed area and did not have the density of population of other urban conurbations. The determining factors of any prevailing scientific culture in Shropshire may therefore be conditioned differently to those examples already considered.

The influence of scientific activity in eighteenth-century economic development is a defining feature of 'Industrial Enlightenment' and Mokyr sets out the relationship between contemporary science and industry.<sup>412</sup> He draws attention to the desire by both industrialists and scientists to establish communications through both informal personal contact and correspondence, his focus in this instance being upon applied science, rather than natural

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<sup>411</sup> Elliott, P. A., *Enlightenment, modernity and Science: geographies of scientific culture and improvement in Georgian England* (London, 2010), p. 183

<sup>412</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009) pp. 85-92, p. 87.

philosophy in its broader sense. Humphrey Davy recorded the state of contemporary cross-disciplinary collaboration: ‘...in consequence of the multiplication of the means of instruction, the man of science and the manufacturer are daily becoming more assimilated to each other.’<sup>413</sup> There are observable examples within Shropshire: The presence of itinerant science lecturers within the county and region is highlighted in Chapter 6; Dundonald’s contacts with William Reynolds, John Wilkinson and others are largely centred on chemical processes; those between Watt and Reynolds reflect the wider span of their mutual interests incorporating chemistry and engineering. Scientists of the reputation of Joseph Black, Thomas Beddoes and Samuel More had personal contact with Shropshire manufacturers and John Wilkinson had a direct source to current scientific information within the family, from his brother-in-law Joseph Priestley. Whether the knowledge imparted by Priestley was beneficial to Wilkinson’s business interests is questionable but he dutifully supplied Wilkinson with copies of his latest publications, even after he had emigrated to America.<sup>414</sup> Within the wider geographical frame of reference, Mokyr considers that much of the advice given by scientists was inadequate, but in Enlightenment terms that is largely irrelevant. Communications were established and employed, and above all attempts at improvement were pursued: it carries the hallmarks of Enlightenment activity.

The sites of scientific activity employed by Shropshire industrialists were, in respect of mechanical and utilitarian science, largely the foundry or ironworks. William Reynolds had financial interests in a glassworks at Wrockwardine, an alkali plant at Wombridge and in John Rose’s porcelain factory at Coalport which would have afforded the facilities to explore other chemical processes.<sup>415</sup> He was also the only Shropshire industrialist known to have had a

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<sup>413</sup> Davy, H., ‘A discourse, introductory to a course of lectures on chemistry,’ in *The collected works of Sir Humphrey Davy*, Davy, J. ed., Vol. 2 (London, 1802, 1840 ed.) p. 321.

<sup>414</sup> For example letters from Joseph Priestley to John Wilkinson, Warrington Library, Ref: WMS 2/28, Sept 1793; WMS 2/65 April 30 1801.

<sup>415</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed. 2000), pp. 88, 107.

laboratory of his own, which he was pleased to show to visitors.<sup>416</sup> The probate sale catalogue of Abraham Darby III lists a small collection of instruments held in his study: a pair of microscopes, two Senex globes, an electrical machine, two cases of mathematical instruments, a camera obscura and air pump, which, together with the library, present the appearance of the appurtenances of a gentleman's interest in science rather than the pursuit of knowledge through experimental means.<sup>417</sup> Abraham III's credentials as an innovative industrialist have already been established and his election as a member of the Society of Arts in 1777 and their award of a gold medal to him in 1788 attest to the respect in which he was held.<sup>418</sup>

Exemplification of scientific interest on the part of some Shropshire industrialists raises the question of the degree to which mass has to be achieved to establish a cultural paradigm and whether such scale existed, either amongst its industrialists or the Shropshire population generally. Mokyr speculates that those pursuing Enlightenment ideals may have represented ten to fifteen percent of the population and the scientific interests of those industrialists together with those of other consumers of philosophical knowledge, are the subject of a later chapter.<sup>419</sup>

#### **4.4 Acquisition and Diffusion of Useful Knowledge by Shropshire Industrialists**

The opportunity for industrialists and men with an interest in science and mechanics to exchange useful knowledge was afforded in a variety of ways. The role of membership of societies such as the Society of Arts, Royal Society and Royal Institution in the dissemination of knowledge has been addressed in historiography but appears to be an avenue not widely

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<sup>416</sup> Ironbridge Gorge Museum Library, 'Transcription of Samuel More's Journal,' 1780, p.23 (original journal page 100); American Quaker Joshua Gilpin in 1776, cited in Trinder, B., *The most extraordinary district in the world: Ironbridge and Coalbrookdale* (London, 1977); Thomas Beddoes cited in Jay, M., *The Atmosphere of Heaven: the unnatural experiments of Dr Beddoes and his sons of genius*, London, 2009, 46.

<sup>417</sup> Ironbridge Gorge Museum Library, *A catalogue of all the extensive and capital well-bred farming stock, etc...belonging to the late Mr Abraham Darby of the Hay Farm, near Madely (sic)...*, 7-12 May 1789; see also Chapter 2.

<sup>418</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed. 2000), p. 101.

<sup>419</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009), p. 39.

utilised by Shropshire industrialists.<sup>420</sup> The ubiquitous coffee houses that prevailed in London and some provincial towns and the later formation of subject-based societies such as the Geological Society, also presented fora for knowledge dissemination.<sup>421</sup> The importance of networks in the furtherance of intellectual activity and knowledge transfer was explored in the previous chapter and they were developed by Shropshire industrialists in respect of business and technical development. Ian Inkster suggests personal relationships were arguably more important to this end than institutional membership and the apparent paucity of philosophical associations, or other organisations pursuing knowledge in Shropshire in the eighteenth century may be indicative of a number of factors.<sup>422</sup>

The dispersed nature of the industries that underpinned a major proportion of the local economy may have contributed to the failure of a substantial urban centre to evolve within the county. This is of significance if one subscribes to the view that eighteenth-century science culture developed primarily in an expanding urban environment.<sup>423</sup> That most of those industrialists engaged in process innovation and engineered improvement, resided or had their principal place of business within easy access of the county town would tend to negate that argument in the case of Shropshire. The apparent prominence of Quaker ironmasters may also be seen as a determinant in the lack of a philosophical society prior to 1830. Richard Reynolds, for example, reputedly eschewed the sociability of the quarterly ironmasters meetings and the consequent opportunity to exchange information, on religious principles.<sup>424</sup>

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<sup>420</sup> For example, Clark, P., *British clubs and societies, 1580-1800: the origins of an associational world*, (Oxford, 2001); Miller, D. P., 'The usefulness of Natural Philosophy: The Royal Society and the culture of Practical Utility in the later eighteenth century,' in *British Journal for the history of science*, vol. 32, No. 2 (June), (1999), pp. 185-201; Stewart, L., 'Other centres of calculation, or where the Royal Society didn't count: commerce, coffee houses and natural philosophy in early modern London,' in *The British Journal for the history of science*, vol. 32, No. 2, Did the Royal Society really matter in the eighteenth century? (June 1999), pp133-153; Royal Society for the Encouragement of Arts and Manufactures, Membership/ Fellowship printed lists and subscription books, 1754-1986; John Wilkinson was elected a Fellow of the Society of Arts and William Reynolds was a proprietor of the Royal Institution.

<sup>421</sup> McInnes, A., 'The emergence of a leisure town: Shrewsbury, 1660-1760,' *Past and Present*, 120 (Aug 1988), pp. 53-87; see Chapter 6.

<sup>422</sup> Inkster, I., 'Introduction: aspects of the history of science and science culture in Britain, 1750-1850 and beyond,' in Inkster, I. and Morrell, J., (eds.), *Metropolis and province: science in British culture, 1780- 1850* ( London, 1983) pp. 11-54, p. 20.

<sup>423</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed. 2000), p. 199; Weisberger, R. W., *Speculative freemasonry and the Enlightenment: a study of the Craft in London, Paris, Prague and Vienna* (New York, 1993).

<sup>424</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed. 2000), p. 83.

His son William, however, drew many to Ketley, irrespective of religious affiliation and provided hospitality at his home, Bank House. It seems that there was no doctrinal reason proscribing membership of bodies outside the Society of Friends other than issues of personal conscience. Quakers were also being accepted into the Royal Society in the eighteenth-century.<sup>425</sup> It should also be borne in mind that the majority of contemporary Shropshire industrialists were not Quakers. There is little evidence of leading industrial figures engaging in freemasonry as a means of knowledge exchange and similarly with the distinguished national societies. John Wilkinson was elected to the Society of Arts in 1761 and enjoyed the friendship of its secretary Samuel More for many years but the society's membership records do not indicate that industrialists in eighteenth-century Shropshire were drawn to membership of such bodies in any numbers.<sup>426</sup>

Exploring intellectual networks associated with industrial activity remains a productive strand of enquiry. In addition to meetings arising within the business environment, family, faith-based contact and sociability were all constructive fora affording enhancement of technical knowledge and innovation. The flow of knowledge through personal association was frequently two-way or even multi-directional and intellectual networks grew out of those connections. Dundonald's letter to Crawshay of 11 September 1789 comments on Reynold's attempts to resolve puddling process issues.<sup>427</sup> In April 1790 Thomas Dadford, the engineer responsible for construction of the Glamorgan Canal, was directed to Ketley by Crawshay to examine the inclined planes installed by Reynolds on his own canals.<sup>428</sup> Crawshay had proposed the utilisation of inclined planes to overcome a vertical fall of ninety feet on the line of the Glamorgan Canal, but in the event other options were adopted. Engine designers were

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<sup>425</sup> Raistrick, A., *Quakers in science and industry* (York, 1950, 2nd ed. 1993), p. 222.

<sup>426</sup> Royal Society for the Encouragement of Arts and Manufactures, Membership/ Fellowship printed lists and subscription books, 1754-1986.

<sup>427</sup> Scottish Record Office, Ref: 109/G/4, Letter Dundonald to Crawshay, 11 September 1789, cited in Trinder, 'Wm Reynolds,' (2008), p. 20).

<sup>428</sup> Letters Crawshay to Wm Reynolds, 9 April 1790 & to T. Dadford, 15 April 1790, in Evans, C., *The letterbook of Richard Crawshay, 1788-1797* (Cardiff, calendared 1990), p. 62.

finding their way to Shropshire because of the knowledge and the degree of experience in engine design and construction assembled at Ketley, Coalbrookdale and Hazeldine's at Bridgnorth. For his part Reynolds placed himself at the cutting-edge of engine-technology with those involved in the resolution of design-concepts, seeking solutions to practical issues. Reynolds only had a single patent granted regarding his innovative work; in respect of a process for the production of manganese steel. His attitude to the sharing of knowledge was amplified by the American visitor T. P. Smith: 'he had no secrets and wished there should be none where the success of humanity was affected.'<sup>429</sup> Such a philosophy echoes that of his maternal grandfather, Abraham Darby II, mentioned above, but it is not clear whether this was an article of faith amongst Quakers or just a manifestation of personal philosophy. His father Richard had no qualms about sponsoring fellow Quakers, Thomas and George Cranage in the patenting of their own refining process. John Gibbons, the Black Country ironmaster (1777-1851), adopted a similar attitude to William Reynolds concerning his new blast-furnace configuration and yet had no affiliation to dissenting communities. He took the initiative of forwarding copies of his published account of his trials and design modifications to fellow ironmasters.<sup>430</sup>

John Wilkinson's attitude to the preservation of intellectual property rights, both his own and those of others, has already been mentioned and he avidly pursued improvement through experimentation and the procurement of information from others. He was keenly aware of the need to keep abreast of advances in knowledge and to be alert to opportunities that presented themselves. His business interests were geographically dispersed and so were his contacts.

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<sup>429</sup> Patent 2363, 1799, Prosser, R, Superintendent of Examiners at the Patent Office, 'A list of patents granted under the old law 1617-1852 to persons resident in Shropshire,' Shropshire Archives, Ref C20; Smith, T. P., 'Sur la fabrication du fer et de l'acier avec la houille d'après les procédés de M. William Reynolds,' *Journal des Mines*, 1803, pp. 52-60, cited in Torrens, H., *The Reynolds-Anstice Shropshire geological collection, 1776-1981*, *Archives of Natural History*, (1982), 10 (3): 429-441.

<sup>430</sup> Gibbons, J., *Practical remarks on the construction of the Staffordshire blast furnace* (Birmingham), UoB Sp Coll; Ref: rQH1 M5/ 10; Letter from James Foster (Stourton Castle) to John Gibbons (Corbyns Lodge), 20th February 1839, Staffordshire Record Office, Ref: 6060/4/15/1 expressing thanks for 'the little book; letter (same correspondents), dated 21st September 1844, Ref: 6060/4/16/6, thanks for the "valuable little book."; Letter from Francis Downing (Dudley Priory) to John Gibbons, Ref: 6060/4/15/1, offering thanks.

Richard Crawshay was the managing partner of Cyfarthfa ironworks in Glamorgan.<sup>431</sup> He arranged to visit Bradley, Ketley and New Willey ironworks and wrote to his partner, James Cockshutt, of his plans to be at Cyfarthfa on 12 June 1790 with John Wilkinson.<sup>432</sup>

Constructive relationships were developed following this visit to Shropshire. In a letter written on 4 August to William Reynolds, Crawshay advised of gifts of plants and fossils that had been forwarded to Reynolds and his wife, following the recent visit.<sup>433</sup> He made references in the letter to inclined planes and to Dundonald's thoughts on improving refining techniques, all of which gives clear evidence of constructive discussion and conviviality between respected competitors and consequently the pursuance both of their own interests and of the advancement of technical knowledge. By the mid-1790s Richard Crawshay had become the largest producer of bar iron in Britain and his letters to Wilkinson in particular continue until the end of the letterbook in question in 1797.<sup>434</sup>

The relationship with Samuel More was very important to Wilkinson. Trained as an apothecary and chairman of the Society of Arts chemistry committee for five years from 1762 to 1767 he clearly had a more than passing knowledge of the current state of scientific work and those involved in its furtherance.<sup>435</sup> He had proposed Wilkinson for membership of the Society in 1761 which undoubtedly enhanced the latter's credibility amongst his contemporaries and gave direct access to a national centre of knowledge exchange.<sup>436</sup> More was appointed to the vacant position of Secretary to the Society in 1770 which he held until his death in 1799. He regularly undertook lengthy tours in different parts of the country and

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<sup>431</sup> Evans, C., *The letterbook of Richard Crawshay, 1788-1797* (Cardiff, calendared 1990).

<sup>432</sup> Letter from Richard Crawshay to James Cockshutt, 5 June 1790, Evans, C., *The letterbook of Richard Crawshay, 1788-1797* (Cardiff, calendared 1990), p. 66.

<sup>433</sup> Letter from Richard Crawshay to James Cockshutt, 5 June 1790, Evans, C., *The letterbook of Richard Crawshay, 1788-1797* (Cardiff, calendared 1990), p. 70.

<sup>434</sup> Evans, C., *The letterbook of Richard Crawshay, 1788-1797* (Cardiff, calendared 1990), p. xvi.

<sup>435</sup> Allan, D. G. C., 'More, Samuel (1726-1799)', *Oxford Dictionary of National Biography*, (Oxford 2007); online edn, Jan 2008 [<http://www.oxforddnb.com/view/article/38826>, accessed 22 Nov 2012]

<sup>436</sup> Dawson, F. C., *John Wilkinson: King of the Ironmasters* (Stroud, 2012), p. 32.

maintained comprehensive journals of his travels.<sup>437</sup> When in the Midlands he frequently travelled in the company of Wilkinson, staying at Broseley and Castle Head.<sup>438</sup> In July 1776 having met Wilkinson in Birmingham and dined at Soho with several of the Lunar Society men, they moved on to Shropshire and toured the iron works and mines.<sup>439</sup> More took detailed notes of the equipment and processes he witnessed, met Richard Reynolds and his son, William and then moved on to Etruria to spend time with Josiah Wedgwood. On his 1780 visit, the Iron Bridge was complete and he made copious notes on its features and spent time with the Darbys, Reynolds and Rathbones.<sup>440</sup> He socialised with local landowners like Sir Watkin Williams Wynn and on his 1783 tour he dined with Archdeacon Joseph Plymley and his sister, Katherine. On 20 July 1780 More visited Wilkinson's new works at Snedshill where he examined 'an ingenious wind funnel' for conveying fresh air down the mine shafts. The furnace buttresses are recorded as being constructed of arches, which accommodated dwelling houses for the workmen: the homes being kept warm by the heat of the furnace. Later the same day he visited Ketley where William Reynolds had erected a steam engine eighty yards underground in the mine for drainage purposes. More and Wilkinson, together with Richard, William and Joseph Reynolds, descended the mine to examine the engine working.

During his trips he regularly viewed or took part in trials of materials and production processes and whilst at Honeybourne's glassworks in Stourbridge, he undertook chemical experiments with the declared aim of improving the quality of glass.<sup>441</sup> He gave advice in addition to seeking information. For example in 1783 at Bersham he advised workmen on the

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<sup>437</sup> 'Transcription of Samuel More's Journal,' Ironbridge Gorge Museum Library. Such original journals that survive remain in private ownership and transcriptions were provided by the owner to Frank Dawson for his biography of John Wilkinson. From correspondence between Dawson and the owner it appears that until the original journals are published or handed over to a public repository, the full extent of the span of the journals or the veracity of the transcriptions cannot be substantiated.

<sup>438</sup> Dawson, F. C., *John Wilkinson: King of the Ironmasters* (Stroud, 2012), pp. 67-9.

<sup>439</sup> 'Transcription of Samuel More's Journal,' Ironbridge Gorge Museum Library.

<sup>440</sup> 'Transcription of Samuel More's Journal,' Ironbridge Gorge Museum Library.

<sup>441</sup> 'Transcription of Samuel More's Journal', 27<sup>th</sup> July 1780, Ironbridge Gorge Museum Library.

formulation of a solder to overcome a production problem they had encountered in producing improvements to valves for a Watt engine:

I made some for them by melting \_\_\_\_\_ of fine Brass with \_\_\_\_\_ of Zink (sic) in a Crucible the Metals being covered with Salt and when the whole was in fusion pouring the matter into water, the Workman on trying this Composition declared it to be the best he ever had met with.<sup>442</sup>

Acting as a node of knowledge exchange, he sought out manufacturers, engineers and scientists, acquainted himself with their innovative activities and took the opportunity to convey such knowledge to those to whom it was of interest. As such he was an important component in the intellectual communities of Shropshire, and other regional industrial centres, in the late eighteenth century.

Family and faith-based relationships afforded a potentially rich seam of useful knowledge. The inter-marriages between the Darby, Reynolds and Rathbone families presents the most visible example of that potential, on both counts and have been extensively documented by Raistrick and Trinder in particular. The extent to which knowledge transfer was occasioned is, however, difficult to determine. At the time of his father's death Abraham Darby II was six years old; subsequently his own son, Abraham III, was thirteen, when his father died. Consequently inter-generational formative influence received from their respective fathers was likely to be minimal. That both men made significant innovative contributions to local industrial development reflects not only on their own innate abilities but on the local environment within which they developed. Richard Reynolds undoubtedly offered great guidance to Abraham III whilst in management control of the Coalbrookdale Company, as well as to his own son William but despite being a noted philanthropist and successful businessman, is not considered to be a significant innovator. Abraham III worked closely with

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<sup>442</sup> 'Transcription of Samuel More's Journal,' 26<sup>th</sup> August 1783, Ironbridge Gorge Museum Library, p. 7 (original journal page 30).

his cousin William at a time when the Coalbrookdale partnership's ironworks were expanding in the final quarter of the eighteenth-century. The erection of the Iron Bridge by Darby became emblematic of the period and reflected a widespread cultural enthusiasm for improvement, as witnessed by the visitors who came to see it, and it is certain that Darby and Reynolds were stimulating each other's creative instincts.

Such visibility of generational transfer of knowledge as afforded by extant records of business activity, are frequently more indicative of continuance of business by second and subsequent generations than perpetuation of incremental increases in knowledge. The development of the Botfield businesses based on Old Park Ironworks, illustrate that issue.<sup>443</sup> Thomas Botfield developed the Old Park Ironworks, Dawley from 1788, which was inherited on his death in 1801, by his three sons. By 1806 Old Park was the largest ironworks in Shropshire and the second largest in the country and ownership was ultimately to pass to a third generation in Beriah Botfield III in 1850.<sup>444</sup> The conclusion to be drawn from Trinder's narrative is of improvement attained by adoption of techniques developed elsewhere; the attraction of skilled individuals, such as Gilbert Gilpin, John Wilkinson's former agent; and by increases in capacity, to either match or anticipate demand.<sup>445</sup> Two patents were granted to Thomas Botfield II, for iron roofs in 1809 and a form of 'hot-blast' in 1828 but there is a feeling of organic growth conditioned by investment in the expansion of Old Park Ironworks rather than development on the strength of innovation, unless closer research into the surviving records of the company contradicts that perception.<sup>446</sup> The Darby and Botfield families demonstrate the progressive development of Shropshire iron trades businesses through several generations and

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<sup>443</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p 82; Hayman, R., 'The Shropshire Wrought-Iron Industry, c1600-1900: a study of technological change', Unpublished PhD thesis, University of Birmingham, 2003, p. 152.

<sup>444</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p 82.

<sup>445</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p 123. Hayman, R., 'The Shropshire Wrought-Iron Industry, c1600-1900: a study of technological change', Unpublished PhD thesis, University of Birmingham, 2003, p. 97.

<sup>446</sup> Prosser, Richard (Superintendent of Examiners at the Patent Office), A list of patents granted under the old law 1617-1852 to persons resident in Shropshire, Shropshire Archives, Ref C20, patents 3246 and 5396.

from different sides of the religious dissent divide: the Darbys being Quakers and the Botfields, Anglicans. Manifestations of the observance of their faith, such as the proffering of hospitality and the attendance at periodic regional or national meetings of the Society of Friends, presented the Quakers with the opportunity to meet others and engage on other than religious grounds. It is not clear to what extent that opportunity was practically employed in a business sense by the ironmasters of Shropshire. Quaker historian Arthur Raistrick declares that ‘Friends in the same way of business’ would discuss matters of trade but the exchange of useful knowledge, rather than gossip, may not have been a significant by-product of such assembly or congregation.<sup>447</sup>

The idea that Quakers distanced themselves from other groups in terms of business or cultural practice is, by the second half of the eighteenth-century less apparent than a hundred years earlier. William Reynolds invited, amongst others, Thomas Beddoes and Richard Crawshay, both non-Quakers, to stay at Bank House. He engaged in experimentation and the exchange of knowledge with scientists and the brightest engineering talent of the time, most of whom did not share his religious orientation. He was estranged from the Society of Friends due to his choice of marriage partner but he seemingly retained his ethical principles and relationships with Quaker family and friends, even to the point of continued attendance at meetings. The economic history of Shropshire is distinguished by the presence of the Quaker ironmasters to the point of their religious affiliation being as notable as their significance in the onset of Industrial Revolution. Paul Wood considers that members of the Society of Friends were influenced as much by the philosophical premises of Enlightenment and Romantic ethics as non-Quakers and in their engagement in active campaigns for improvement, provided an avenue for closer engagement with the ‘greater intellectual

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<sup>447</sup> Raistrick, A., *Quakers in science and industry* (York, 1950, 2<sup>nd</sup> ed. 1993), p. 45.

world.’<sup>448</sup> Reference to the Quaker involvement in humanitarian action within Shropshire was highlighted in Chapter 1, however it is apparent from this study that their contribution to a culture of Industrial Enlightenment within the region, had less to do with articles of faith and more to do with the abilities of individuals.

Intellectual communities established for the furtherance of knowledge and economic advancement functioned as much through correspondence as face-to-face contact. A case study, based on a collection of letters between two industrialists, exemplifies the means employed in the pursuit of improvement and witnesses the evolution of a particular relationship. It provides insight into the development of an industry within Shropshire other than those associated with the production of iron and mineral extraction. As much as can be established from one side of an epistolary conversation, it seems that the flow of information between William Strutt and Charles Bage encompassed the sharing of practical experiences, both in the construction of mill buildings and experimental testing of processes.<sup>449</sup> Bage’s lack of building construction experience led him to draw extensively on Strutt’s reservoir of knowledge at the outset, but over time his acquired understanding redressed the balance of knowledge flow between them, to the point of debate and criticism of Strutt’s stance on issues. From the content of some of the letters it is clear that periodic visits between them strengthened their relationship and is worthy of detailed examination in the context of the transfer of knowledge.

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<sup>448</sup> Wood, P., *Science and dissent in England, 1688-1945* (Aldershot, 2004), p. 218.

<sup>449</sup> Letters written by Charles Bage of Shrewsbury to William Strutt of Derby, Shropshire Archives., Ref: 6001/2657/1-38.

## 4.5 Case Study - Charles Bage (1751-1822) and Ditherington Flax Mill

Image: 4/1



**Ditherington Flax Mill, Shrewsbury, Shropshire, with permission of Shropshire Archives**

From the completion of its construction in 1797, Ditherington Flax Mill in Shrewsbury was marked as being something special, being described by the local newspaper as ‘a very important improvement.’<sup>450</sup> It was more than one hundred and fifty years, however, before its true position as the world’s first multi-storey iron-framed building was recognised and its place in the history of structural engineering and construction secured.<sup>451</sup> Trinder’s journal article on the building recorded the state of current knowledge up to the early 1990s. This case study seeks to anchor the influence of Ditherington Flax Mill and its designer by determination of formative influences, associated knowledge dissemination and the nature of

<sup>450</sup> *Shrewsbury Chronicle*, 1<sup>st</sup> September 1797.

<sup>451</sup> Bannister, T., ‘The First Iron-framed Buildings,’ *Architectural review*, CVII (1950), pp. 231-246; Skempton, A. W. and Johnson, H. R., ‘The first iron frames,’ *Architectural Review*, Manchester, (1962), pp. 175-186; Trinder, B., ‘Ditherington Flax Mill, Shrewsbury- A re-evaluation,’ *Textile History*, 23 (2) (1992), pp. 189-223.

incorporated innovation. It considers the degree to which they embody expressions of the application of Enlightenment ideals.

#### 4.5.1 The role of Charles Woolley Bage

In the context of the design and construction of the mill the choice of Bage as designer remains surprising, as does his continued involvement in the running of the flax-spinning business as a partner. His senior partner, John Marshall commented, 'Mr Bage was possessed of talent and understanding but was not a man of business.'<sup>452</sup> Prior to his appointment he was a land surveyor in addition to trading as a wine-merchant in Shrewsbury, as evidenced by contemporary trade directories and extant copies of reports or accounts for services rendered, dating from 1774 until 1793.<sup>453</sup> There is no documentary evidence of any previous practical experience in the fields of structural engineering, iron production or, prior to 1797, involvement in textile production. Historians have consequently turned to familial influence and the network of acquaintances established during his time in Shrewsbury as possible sources of his interest in, or incidental knowledge of, iron and structural engineering in particular.<sup>454</sup> His father, Robert, had a financial interest in the Wychnor Ironworks between 1765 and 1781, in addition to the paper manufactory that he ran from 1751 until the time of his death in 1801 and it is possible that Charles had an involvement in the ironworks.<sup>455</sup>

However the timing of his relocation to Shrewsbury has some relevance. Trinder places Bage in the town by 1776 but in 1770 two young men by the name of Bage were put to

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<sup>452</sup>Marshall, J., 'My Life,' p. 13, cited in Rimmer, W. G., *Marshalls of Leeds, Flax spinners, 1788-1886* (Cambridge, 1960), p. 62.

<sup>453</sup> Shropshire Archives, Mostyn-Owen Collection, 3890/4/10/2/66-68, *Accounts from Slater and Bage for surveying in June 1782 and 1776*; Shropshire Archives, 1779, D3651/B/5/1/9, *Survey and valuation of estates...Thomas More*; Shropshire Archives, Ref: D3651/B/5/2/26, *Bowman and Bage award in exchange of lands, Aug 1797*; *Bailey's British Directory*, 1784; *Merchant's and Trader's Useful Companion for the year 1784*, both Ancestry.co.uk, U.K. and U.S. Directories, 1680-1830;

<sup>454</sup> For example, McConnell, A., 'Bage, Charles Woolley (1751-1822)' *Oxford Dictionary of National Biography*, Oxford, 2008; Dick, M.M., 'Charles Bage and the Flax Industry,' <http://search.revolutionaryplayers.org.uk>, [accessed 20 June 2012.], Pattison, A., *William Hazeldine, Shropshire Ironmaster and Millwright: A reconstruction of his life, and his contribution to the development of engineering, 1780-1840*, unpublished M. Phil Thesis, 2011, University of Birmingham, p. 71.

<sup>455</sup> Kelly, Gary, 'Bage, Robert (1728?-1801)', *Oxford Dictionary of National Biography*, 2004; online edn, May 2006 <http://www.oxforddnb.com/view/article/1028>, accessed 24 July 2012 ]; Goss., J., 'A biography of Robert Bage,' [revolutionaryplayers.org.uk](http://www.revolutionaryplayers.org.uk), [accessed: 23 July 2012]; Pattison, A., *William Hazeldine, Shropshire Ironmaster and Millwright: A reconstruction of his life, and his contribution to the development of engineering, 1780-1840*, M. Phil Thesis, 2011, University of Birmingham.

apprenticeship, Robert to a land surveyor in Shrewsbury named Thomas Slater and Edward to John Oldershaw, a surgeon in Tamworth. Edward (1754-1812) was clearly Charles' younger brother, as he subsequently pursued a career as an apothecary in Tamworth.<sup>456</sup> Thomas Slater, however, is acknowledged to have been Charles Bage's business partner in conducting land surveys as early as 1774.<sup>457</sup> Evidence from genealogical records does not identify any Robert Bage likely to be a candidate for apprenticeship at that time within the Midlands area but that is not conclusive given that the introduction of legislation to enforce registration of births, marriages and deaths was not introduced until 1837.<sup>458</sup> The coincidence that Charles and an unrelated apprentice named Robert Bage were both aligned to Thomas Slater seems too great. William Hutton, the historian and great friend of his father, recorded in his memoir of Bage senior that he had three sons, one of whom had died as a young man.<sup>459</sup> These were Charles, Edward and John, the latter dying at the age of 25 in 1783.<sup>460</sup> It seems probable that a clerical error was made in the completion of apprentice registration and the name of the apprentice's father was entered on the apprenticeship form, as was customary on other apprenticeship papers. At this time Charles would have been eighteen and John, at eleven, would have been a little young and it is therefore more probable that the apprentice was Charles. It would also clarify the circumstances of his move from the family home at Elford to Shrewsbury and pursuit of a career to the age of forty-four as a land surveyor. Examination of extant survey reports, maps and accounts identify a single instance where Charles Bage is recognisably a participant in conducting the survey, others being credited to 'Mr Bage' or 'Slater and Bage'

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<sup>456</sup> Kelly, Gary, 'Bage, Robert (1728?-1801)', *Oxford Dictionary of National Biography*, 2004; online edn, May 2006 <http://www.oxforddnb.com/view/article/1028>, accessed 24 July 2012]; ancestry.co.uk, Register of Duties paid for Apprentices Indentures, 1710-1811, *Board of stamps Apprenticeship books*, Series IR 1, piece 26.

<sup>457</sup> For example- Staffordshire Record Office, Ref: D(W)1721/2/30- Bagot family of Blithfield- map of estates with manor of Newton, parish of Blithfield and county of Stafford. Manor the property of John Hawkes Esq, Made in 1774 by Slater and Bage, (also see fig 4/1); Trinder, B., 'Ditherington Flax Mill, Shrewsbury- A re-evaluation,' *Textile History*, 23 (2) (1992), 189-223, 193; McConnell, A., 'Bage, Charles Woolley (1751-1822)' *Oxford Dictionary of National Biography*, Oxford, 2008;

<sup>458</sup> Births and Deaths Registrations Act 1836.

<sup>459</sup> Hutton, W., 'Memoirs of Mr Bage,' *Monthly Magazine, or, British Register*, Feb 1800-June 1836, Jan 1802, 12, 81, *British Periodicals*, p. 478.

<sup>460</sup> *International Genealogical Index*, <http://FamilySearch.org>, [accessed 20 July 2012].

(see fig. 4/1). But conversely there is no identifiable alternative Bage practicing as a land surveyor within the region.

<b>Fig. 4/1</b>		
<b>Date</b>	<b>Estate</b>	<b>Conducted By</b>
1774	John Hawkes, manor of Newton, Blithefield	Slater & Bage
1776	Survey and map Berrington township	Slater & Bage
1777	Thomas Congreve, Pentreheylin	T. Slater
1779	Thos More	Slater & Bage
1780	Francis Lloyd	Slater & Bage
1780	Various	Mr Bage
1782	Mr Congreve	T. Slater
1782	Mr Laxdale (citing work also in 1776)	Slater & Bage
1788	Congreve, Pentreheylin	Bishton & Bage
1788	Shrewsbury Gaol	Bishton & Bage
1792	Owen & Daker- land exchange	Henry Bowman & Chas Bage
1793	Thos Eyton	T. Slater

**Estate maps or surveys conducted by Messrs Bage & Slater**

His residence in Shrewsbury as a seventeen/ eighteen year old in 1770, therefore casts doubt on Bage's opportunity to gain significant knowledge of the properties of iron from any involvement at Wychnor Ironworks. The period between 1770, when any potential participation in Wychnor would have ceased, and 1795/6 when the mill in Shrewsbury's

Castle Foregate was under development, is considerable. Without some form of supplementation of knowledge and participatory activity in the intervening period the question of why he would be an obvious candidate for the role of designer of the mill remains. William Hutton points to Robert Bage's good character and his intellectual capabilities.<sup>461</sup> He was assiduous in his pursuit of self-improvement, learning music, French and Latin without a teacher. In attending mathematics lessons, he was in a short time teaching the master. Hutton comments that Robert's sons 'inherit a large portion of their father's talents,' which may explain Charles' professed ability to acquire information and his empirical pursuit of knowledge for particular purposes. It does not resolve the issue of why it did not manifest itself until he was middle-aged.<sup>462</sup> It may be that like many socially-minded individuals of the latter half of the eighteenth-century his interest in philosophical pursuits manifested themselves as expressions of fashion or dilettantism. Bage's historical reputation rests firmly upon his standing as designer of Ditherington Flax Mill despite almost all surviving documentary material relating to potentially enlightened activity on his part, originating in the period after the construction of the mill. Primary sources that pre-date 1797 relate to business activities, including mapping and surveys of estates and accounts for the supply of wines and liquors (see Fig. 4/1).<sup>463</sup> The premise that Bage developed an interest or competency in structural engineering or the utilisation of iron prior to 1796 through a circle of acquaintances runs into a familiar problem. Although geographical proximity and the consequent opportunity for association on subjects of mutual interest may have existed, there is little discernible evidence, in this instance, of whether such exchanges arose and with what

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<sup>461</sup> Hutton, W., 'Memoirs of Mr Bage,' *Monthly Magazine, or, British Register*, Feb 1800-June 1836, Jan1802, 12, 81, British Periodicals, pp. 478-9.

<sup>462</sup> Hutton, W., 'Memoirs of Mr Bage,' *Monthly Magazine, or, British Register*, Feb 1800-June 1836, Jan1802, 12, 81, British Periodicals, pp. 478-9.

<sup>463</sup> The map of the manor of Newton, Blithfield dated 1774 is the earliest reference to Bage working as a land surveyor in conjunction or partnership with Thomas Slater of Shrewsbury, Staffordshire Record Office, Ref: D(W)1721/2/30; Fig. 4/1 identifies surveys conducted by Bage and others.

outcome. Bage and Telford were, however, both engaged on working on the site of the new Shrewsbury Gaol in 1787-8, Bage in a number of roles primarily associated with surveys of the site and securing of properties being compulsorily acquired to make way for the new building.<sup>464</sup> Telford was employed as surveyor for the building of the Gaol and scope existed for knowledge transfer on construction issues, although there is no evidence of Bage putting any such acquired knowledge to use in a practical sense over the course of the following eight years. Trinder has pointed to the group of intellectually active people functioning in a variety of enterprises and social roles that provided opportunity for discourse and mutual intellectual stimulation in the final quarter of the eighteenth-century. The intellectual consequences of any such loose agglomeration are important to this thesis and are developed in a following chapter but there is no extant evidence that puts Bage in such an associational relationship with members of this group.<sup>465</sup>

#### **4.5.2 Charles Bage and William Strutt**

Much has been made of the relationship between Charles Bage and William Strutt of Derby, based on their early family contacts and surviving letters spanning more than twenty years. Undoubtedly the correspondence between Bage and Strutt gives an important perspective not only on the position of Bage in a Shropshire Enlightenment but also on the nature of the contemporary transfer of knowledge.<sup>466</sup> Although both men were born in Derby, the Bage family had moved to Elford in Staffordshire around 1752, four years before Strutt's birth.<sup>467</sup> Family and friends remained within the town, no doubt prompting periodic return visits, and

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<sup>464</sup> Minutes of meetings of the Commissioners appointed under the acts for building a new Shirehall, 1783, and for building a new Gaol and House of Correction, 1786.

<sup>465</sup> Trinder, B., *A history of Shropshire*, Philimore (London, 1983, 2nd ed 1998), p. 79.

<sup>466</sup> Skempton, A. W. and Johnson, H. R., 'The first iron frames,' *Architectural Review*, Manchester, 1962, pp. 175-186; Trinder, B., 'Ditherington Flax Mill, Shrewsbury- A re-evaluation,' *Textile History*, 23 (2) (1992), pp. 189-223; McConnell, A., 'Bage, Charles Woolley (1751-1822)' *Oxford Dictionary of National Biography*, Oxford, 2008; Shropshire Archives, Ref: 6001/2657/1-38, Letters written by Charles Bage of Shrewsbury to William Strutt of Derby.

<sup>467</sup> Hutton, W., 'Memoirs of Mr Bage,' in *Monthly Magazine or British Register*, Jan 1802, 12, 81, 478-480, British periodicals, accessed 14th July 2012.

when Robert Bage's 'very particular friend' Erasmus Darwin moved to Derby in 1783 Robert joined the nascent Derby Philosophical Society, along with William Strutt and other local Derby intellectuals.<sup>468</sup> He was a 'non-resident' member however, the society retaining only a small 'resident group' and functioned, according to Elliott, 'as a regional corresponding association and library.'<sup>469</sup> Strutt was engaged in experimentation with Darwin on galvanism and electricity and succeeded to the presidency of the society on Darwin's death in 1802. The mutual friendship of both Strutt and Robert Bage with Darwin created a conduit for information flow.<sup>470</sup> Certainly Strutt's involvement in building the new Derby mill in 1792/3 would have been in the public domain and when the prospect of the construction of the Shrewsbury flax mill was under discussion an entrée to Strutt through the Derby Philosophical Society or Darwin connection with Robert Bage may have seemed attractive to the project's partners. It offers a plausible alternative to belief in the existence of any latent abilities in iron technology or construction that Charles Bage may have retained from his youth. Being the foremost mill architect within the region at this time the partners may have had hopes that Strutt might be induced to undertake the design and construction himself.<sup>471</sup>

Charles Bage moved from Elford to Shrewsbury probably in 1770, and away from the likelihood of chance meetings with William Strutt through family connections. Whilst it is possible that a long-distance acquaintance had been initiated, the earliest extant letter, written by Bage to Strutt in late 1795 or early 1796, does not give an impression of an established friendship, particularly in comparison with the warmth of correspondence dated from 1802 onwards.<sup>472</sup> This letter clearly continues an ongoing correspondence relating to the

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<sup>468</sup> Wardle, R. (ed), *Godwin and Mary; letters of William Godwin and Mary Wollstonecraft*, (London 1967) p. 99..

<sup>469</sup> Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850* (Manchester, 2009), p.73.

<sup>470</sup> Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850* (Manchester, 2009), p.74

<sup>471</sup> Hutton, W., 'Memoirs of Mr Bage,' in *Monthly Magazine or British Register*, Jan 1802, 12, 81, 478-480, British periodicals, accessed 14th July 2012.

<sup>472</sup> Shropshire Archives, 9<sup>th</sup> and 14<sup>th</sup> May 1956, Ref, 6001/2657/3-5, Professor Arnold Skempton's letters to J.L. Hobbs, suggest a date of May 1796 or earlier, tying in Bage's references to 'inverted arches' as possibly relating to foundations, construction of which had not yet

construction of the Shrewsbury flax mill, on which Strutt must have previously offered advice. Considerations that Bage had a previously acquired knowledge of iron, that would support his appointment as designer of the flax mill, are further tempered by his apparent lack of understanding of the characteristics of iron as displayed in this letter. It is difficult to agree with Trinder's assertion that "Bage had a remarkable understanding of the structural properties of iron," if considered in the context of this early letter: the same reservation applies to proficiency in basic construction techniques.<sup>473</sup> That such an understanding came later cannot be disputed.

Comprehension of the technical issues surrounding the use of cast iron as a structural material was not well-developed at the end of the eighteenth-century, particularly amongst builders and engineers, or those who commissioned them. But growing interest manifested itself in the early 1790s with its utilisation in construction of a number of churches.<sup>474</sup> In terms of its application in infrastructure, awareness was heightened in Shropshire following the floods in February 1795 which damaged or destroyed many bridges and roads. Discussion arose over the merit of constructing replacement bridges of iron rather than masonry.<sup>475</sup> The extent of such debate and expressions of interest in iron technology, beyond those who had a vested interest in such applications, is open to question. The businessman Thomas Eyton is credited by Telford with suggesting the utilisation of iron for the replacement of Longdon-on-Tern aqueduct, which has been taken as exemplification of wider diffusion of interest in iron.<sup>476</sup>

Eyton was a banker, landowner and a business partner of the ironmaster William Reynolds,

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been determined upon. In fact 'inverted arches' were associated with vaulting in ceilings/floors but in terms of dating may only move the timeframe by a few weeks. By the time of his article in 1962 he had changed his mind to a date of possibly July or August 1796; Shropshire Archives, Ref: 6001/2657/2, Letters written by Charles Bage of Shrewsbury to William Strutt of Derby; Skempton, A. W. and Johnson, H. R., 'The first iron frames,' *Architectural Review*, Manchester, 1962, 175-186, 182

<sup>473</sup> Trinder, B., 'Ditherington Flax Mill, Shrewsbury- A re-evaluation,' *Textile History*, 23 (2) (1992), pp. 189-223, p. 193.

<sup>474</sup> Skempton, A. W. and Johnson, H. R., 'The first iron frames,' *Architectural Review* (Manchester, 1962), pp. 175-186, p.179.

<sup>475</sup> For example see Shropshire Archives, Ref: DP212, 'Minutes of Quarter Sessions-Variou Bridges.'

<sup>476</sup> Trinder, B., *A history of Shropshire*, Philimore, (London, 1983, 2nd ed 1998), p.79; Trinder, B., 'William Reynolds: Polymath- A biographical strand through the Industrial Revolution,' in *Industrial Archaeological Review*, XXX:1, (2008), p. 26; Telford, T., in Plymley, J., *General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement*, (London, 1803), cited in Hadfield, C., *Thomas Telford's Temptation: Telford and William Jessop's Reputation*, (Shropshire, 1993), p82.

himself a member of the canal management committee charged with the replacement of the aqueduct. Telford confirmed that the committee had determined that the design and its execution were to be based on discussion and agreement between himself and Reynolds. The prospect of the use of iron at Longdon was more likely to have merely been discussed between Telford and Eyton rather than being a proposal originating with Eyton specifically.<sup>477</sup> The wider cultural climate was dominated by the pursuit of knowledge and self-improvement, and in many industrial areas by an interest in science. Rimmer claims that Bage had such an abiding interest in modern science.<sup>478</sup> Evidence in support of such a claim only manifests itself following the construction of Ditherington flax mill and then it focuses on issues pertaining to business-related interests. Consequently there is a danger that a logical fallacy is being employed to support the claim; that is, facts being determinable after the event are taken to be a pre-condition of the event or process.<sup>479</sup> Examination of the activities of other enlightened figures within the region does not suggest that establishment of the characteristics, metallurgy or improvement of iron was an obvious pursuit of choice for those drawn to the study of natural philosophy, unless it accompanied economic and business concerns.<sup>480</sup>

In the absence of specific expertise in the field of structural iron work and construction Bage would have needed to acquire the knowledge necessary to equip him to design the mill. Much of that knowledge must have come from Strutt. That he did so renders the project a notable achievement. The references contained in the 1796 letter to Strutt certainly indicate that such a process of knowledge acquisition was under way but do not testify to the extent to which the

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<sup>477</sup> Hadfield, C., *Thomas Telford's Temptation: Telford and William Jessop's Reputation* (Shropshire, 1993) p.82.

<sup>478</sup> Rimmer, W. G., *Marshalls of Leeds, Flax spinners, 1788-1886* (Cambridge, 1960), p59.

<sup>479</sup> Such as the *post hoc ergo propter hoc* fallacy.

<sup>480</sup> For example Trinder, B., 'William Reynolds: Polymath- A biographical strand through the Industrial Revolution,' in *Industrial Archaeological Review*, XXX:1, (2008); Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850*, (Manchester, 2009); Randall, J., (1917 reprint), *Our coal and iron industries and the men who have wrought in connection with them. The Wilkinsons; with portrait of John Wilkinson, "The father of the iron trade," and descriptions of the first iron vessel and the first iron bridge...*, (Madeley, 1876); Uglow, J., *The Lunar Men: The friends who made the future: 1730-1810*, (London, 2002);

project may have been a collaborative process. Bage does, however, refer to others being involved; “Inverted arches we have had under consideration and I have no doubt your opinion will be decisive in their favour” and “We are differently advised about the strength of pillars...,”<sup>481</sup> indicate that not only his partners were involved but other outside opinion had been sought. His new partner John Marshall was a flax spinner in Leeds and in 1791 and 1795 had already commissioned two mills in that town. Although he played no day to day part in the Shrewsbury mill’s management it is inconceivable that he would not have at least had input into structural issues that related to production capabilities, as indeed must the Benyon brothers, who according to Rimmer were “very able businessmen.”<sup>482</sup>

Strutt aside, the sources of that material knowledge remain largely speculative. In terms of structural iron, William Hazeldine had a foundry at Coleham in Shrewsbury, was known by Bage and indeed provided the ironwork for the Ditherington mill.<sup>483</sup> The opportunity therefore existed for constructive input by Hazeldine firstly into the characteristics of cast-iron, but also into aspects of design and the most appropriate method of casting particular items. For example the cast-iron beams, the utilisation of which represent possibly the most innovative facet of the mill design compared with Strutt’s Derby mill, are cast in two halves and vary in depth at different points along the span.<sup>484</sup> Skempton and Johnson believe that such a design requires a possible understanding by Bage of the flexing characteristics of beams as they are made deeper at points where stresses are likely to be greatest. Similar foundry-related influence over design may have been applied to the cast-iron pillars. A characteristic of the

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<sup>481</sup> Shropshire Archives, Ref: 6001/2657/2, Letter Charles Bage to Wm Strutt- probably 1796.

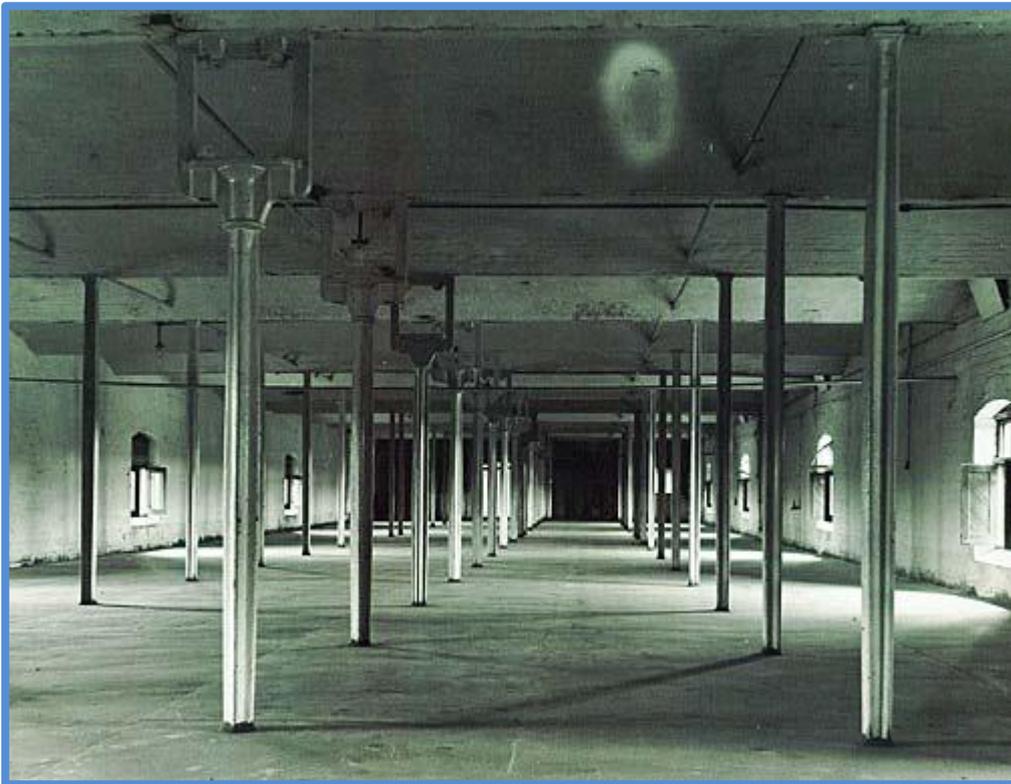
<sup>482</sup> Rimmer, W. G., *Marshalls of Leeds, Flax spinners, 1788-1886* (Cambridge, 1960), p55-6, 58; Skempton, A. W. and Johnson, H. R., 'The first iron frames,' *Architectural Revue*, (Manchester, 1962), p. 178; Trinder, B., 'Ditherington Flax Mill, Shrewsbury- A re-evaluation,' *Textile History*, 23 (2) (1992), pp. 189-223, p. 191.

<sup>483</sup> Trinder, B., 'Ditherington Flax Mill, Shrewsbury- A re-evaluation,' *Textile History*, 23 (2) (1992), p. 190; Pattison, A., *William Hazeldine, Shropshire Ironmaster and Millwright: A reconstruction of his life, and his contribution to the development of engineering, 1780-1840*, M. Phil Thesis, 2011, University of Birmingham; Shropshire Archives, Ref: D3651/D/5/237, Bage & Telford arbiters of Hazeldine trade dispute, *Agreement for resolution of dispute between Hazeldine and Rev Edw Powys and Mr Hodges re outstanding sums, arbitrated by C. Bage and T. Telford*, 1793.

<sup>484</sup> Skempton, A. W. and Johnson, H. R., 'The first iron frames,' *Architectural Revue*, (Manchester, 1962), pp. 175-186, p. 182; Trinder, B., 'Ditherington Flax Mill, Shrewsbury- A re-evaluation,' *Textile History*, 23 (2) (1992), pp. 189-223, p. 195.

columns on the ground and third floors was the modification of their top sections, allowing the passage of shafts, which run the length of the mill, to provide motive power from the steam engine (see Image 4/2).<sup>485</sup>

**Image: 4/2**



**Columns in Ditherington Flax Mill, courtesy of Revolutionary Players**

But the contribution of knowledge by Hazeldine, Telford, Reynolds or any of the other enlightened figures in the local Shropshire community, to Bage's understanding of iron, are more likely to have been project-related than a result of intellectual conditioning within a network: this despite the level of iron-based activity occurring within the region.

In the 1796 letter and those which followed, Bage sought advice or reported to Strutt on steps taken to secure it from other sources which may be taken as an indication of a lack of original knowledge on the subject. In enlightenment terms that is perfectly consistent with the concept

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<sup>485</sup> See also Trinder, B., 'Ditherington Flax Mill, Shrewsbury- A re-evaluation,' *Textile History*, 23 (2) (1992), p. 194.

of ‘improvement,’ whereby advances are made in incremental steps and rarely in giant leaps. He acknowledged, by way of a sketch of the cross-section of his proposed columns, the debt to Strutt’s pillars at Derby and Belper but rationalised his decisions on column-size and load-bearing by original thinking.<sup>486</sup> He based his hypothesis on the structural load-bearing of cast-iron on the results of tests with which he was ‘favoured’ by Joseph Reynolds at Ketley ironworks. In his Memorandum Book Telford recorded the outcome of trials on one inch square cast bars in March 1795 at Ketley, which is noted as having been supplied by Bage.<sup>487</sup> Telford also described experiments on the strength of twenty-nine foot long ‘ribs’ at Coalbrookdale in April of that year possibly cast for Buildwas Bridge and designed by Telford himself. Those same tests are also laid-out by the science lecturer, John Banks: ‘The following experiments were given to me by Messrs Reynolds of Ketley, at the same time requesting me to make them as public as I could, for the advantage of others.’<sup>488</sup> Banks claimed to have repeated the experiments and following additional investigations, hypothesised on the load-bearing capabilities of iron compared to wood: he reflected on comparable costs, setting out rules for making calculations on load-bearing. Bage’s further letters to Strutt on the strength of iron are surprisingly also dated in 1803 and considerations of primacy in such appraisals and theorising therefore come into question and further research is required to resolve the issue (Appendix 4/1). As it stands, the attempt by Bage to produce a rational argument for calculating the load-bearing capacity of cast-iron pillars that he designed for Ditherington is considered notable in the field of structural engineering; that four years earlier Strutt built a mill successfully with cast-iron pillars and no such rationale,

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<sup>486</sup> Letter Charles Bage to Wm Strutt- probably 1796, Shropshire Archives, Ref: 6001/2657/2;

<sup>487</sup> Rickman, J., *Life of Thomas Telford*, (London, 1838), p. 682.

<sup>488</sup> Banks, J., *On the power of machines* (London, 1803), p. 89.

tempers perception of that achievement, but it is Skempton's opinion that his hypothesis remained sustainable well into the nineteenth century.<sup>489</sup>

Clearly the recognition of the potential of cast-iron as a structural material within the region was stimulating the pursuit of knowledge of its load-bearing strength and torsional characteristics amongst manufacturers, engineers and designers.<sup>490</sup> Apart from those directly involved with Longdon Aqueduct, others with an interest in the characteristics of iron were being drawn to Ketley at this time. Benjamin Outram, the canal builder and owner of Butterley Iron Co in Derby visited shortly after April 1795, as did the civil engineer Robert Fulton, who had built the Peak Forest Canal and was to subsequently undertake iron-based construction projects himself. Another potential Derbyshire connection is thereby introduced in to the equation of knowledge dissemination upon which Bage could draw.<sup>491</sup> Hadfield refers to the awareness of the work of others that prevailed amongst engineers; Telford, William Jessop, Outram, Fulton and William Reynolds either had documented contact or worked together in different combinations as will be seen elsewhere in this thesis and offer the presence of an intellectual community functioning across the north of the region.<sup>492</sup>

The issue of construction of the fabric of Ditherington mill is referred to in the 1796 letter. Bage asks Strutt for information concerning the degree of settlement of brickwork, which may have had particular dimensional relevance to the designing of the iron framework, but must be considered to be a lack of understanding of basic construction techniques. Bage would clearly have needed someone with appropriate expertise to fulfil the role of mason but who occupied the role is not known. John Simpson is mentioned elsewhere in this thesis particularly with regard to his association with Telford, Hazeldine and Davidson in many construction projects

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<sup>489</sup> Skempton, A. W. and Johnson, H. R., 'The first iron frames,' *Architectural Review* (Manchester, 1962), pp. 175-186, p.182.

<sup>490</sup> Lawson, J. B., 'Thomas Telford in Shrewsbury: The metamorphosis of an architect into a civil engineer,' in Penfold, A., *Thomas Telford, Engineer*, (London, 1980), p. 15.

<sup>491</sup> Hadfield, C., *Thomas Telford's Temptation: Telford and William Jessop's Reputation* (Shropshire, 1993), p. 91.

<sup>492</sup> Hadfield, C., *Thomas Telford's Temptation: Telford and William Jessop's Reputation* (Shropshire, 1993), p. 93.

and the intellectual community that prevailed for the flow of knowledge between them. Trinder has identified his role in the building of the Ditherington apprentice and clerk's houses at Castle Foregate sometime before 1800.<sup>493</sup> Whether Simpson had any involvement in the mill building or proffered advice on any of the construction issues referred to in the 1796 letter to Strutt is not known. Telford wrote of Simpson in 1798 that, 'he has all of the work of any magnitude in this great and rich district.'<sup>494</sup> He had worked with Hazeldine on St Chad's in 1792, where cast-iron structural supports were used, undoubtedly enhancing his knowledge of its utility in the process. Although Simpson had been appointed jointly responsibly for the masonry work at Pontcysyllte Aqueduct in September 1795 and in February 1796 as contractor for Chirk Aqueduct, also on the Ellesmere Canal, construction was not fully under way.<sup>495</sup> At Pontcysyllte at this time stone cutting was largely taking place, which was unlikely to have impaired his potential involvement at Ditherington.<sup>496</sup>

The Marshall, Benyon partnership had witnessed a catastrophic fire at their Leeds 'B' mill in February 1796 and the well-publicised fireproofing incorporated by Strutt at Derby must have figured in their thoughts in planning the construction of a new mill at Shrewsbury.<sup>497</sup> But this was leading-edge technology and in the absence of Strutt himself, the partnership needed someone to ascertain and adapt the principles and methods employed by him at Derby and the mill under construction by him at Belper. Unlike Bage, William Strutt was an experienced engineer and cotton spinner and much of the relevant knowledge for the construction of Ditherington was probably imparted by Strutt. In his 1796 letter Bage records his familiarity with the structure of the pillars at the Derby mill. What seems clear is that both in

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<sup>493</sup> Trinder, B., 'Ditherington Flax Mill, Shrewsbury- A re-evaluation,' *Textile History*, 23 (2) (1992), p.200.

<sup>494</sup> Telford to Little, 8 Dec 1798, in Gibbs, A., *The Story of Telford: the rise of civil engineering* (London, 1935).

<sup>495</sup> Hadfield, C., *Thomas Telford's Temptation: Telford and William Jessop's Reputation* (Shropshire, 1993), p. 39-41

<sup>496</sup> Hadfield, C., *Thomas Telford's Temptation: Telford and William Jessop's Reputation* (Shropshire, 1993), p. 39-41

<sup>497</sup> Rimmer, W. G., *Marshalls of Leeds, Flax spinners, 1788-1886* (Cambridge, 1960), p62. Rimmer describes the Leeds 'B' Mill as being 'totally destroyed,' citing local newspaper reports. If so its reconstruction and readiness for reoccupation in five months, and being in production by the end of the year, was quite remarkable.

collaboration and on his own account Bage garnered the necessary knowledge and proficiency to complete his remit. As a consequence Ditherington Flax Mill became an iconic symbol in the history of structural engineering. In an Enlightenment context, however, Kant explains that it 'is the process of discovery, the active and critical engagement of the individual, that mattered, not necessarily the end result.'<sup>498</sup>

Fortunately greater visibility of Bage's intellectual activities is afforded in the letters to Strutt following the completion of Ditherington Flax Mill. The thirty-two letters and appended plans dating from 1802 until 1818 present a clearer picture of some of Charles Bage's endeavours and can be seen to fall chronologically into largely subject-related groupings (see Appendix 4/1). He discusses the issue of bleaching in ten letters over a period of seven years until 1815 and within this group of letters he provides analytical responses to suggestions or topics undoubtedly put forward by Strutt. At times Bage fires off a list of questions either as a consequence of his own enquiries or as a reflection on something raised by Strutt:

There is one passage in your letter which I do not clearly comprehend. "You have lately tried warming the water in Redlan by steam but it would not do on acc of the smell not even at 60. By Redlan I suppose you mean the gas vessel in which the goods are suspended, but the word is new to me. Is it necessary to avoid smell, that the water should be so very cold? How is this to be managed in summer by those who have no spring water at command? What is the cause? Is it that the gas requires cooling, & if so might it not be cooled in its progress from the still?"<sup>499</sup>

The major advances in bleaching techniques had been made by such as Berthollet and Scheele in the 1780s and Charles Tennant around the turn of the century. Even James Watt and Joseph Black were conducting extensive experiments on bleaching. Bage's experimentation and enquiries into improvement of the bleaching process, were directed solely to linen but not, apparently, with any degree of success. In 1814 he records, 'I endeavoured to adopt your plan

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<sup>498</sup> Kant, E., *Was ist Aufklärung?* quoted in Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p.7.

<sup>499</sup> Shropshire Archives., Ref: 6001/2657/38, letter written by Charles Bage of Shrewsbury to William Strutt of Derby, 3 April 1810.

of immersing the yarn in the dry gas, but could not make a level colour, so we proceed the old way.<sup>500</sup>

Certainly in the seven years following the Ditherington letter, during which there is no extant correspondence with Strutt, Bage's knowledge of structural iron improves dramatically and in 1803 he is making full-scale load tests on iron roof frames and on the torsional strength of iron (see Image 4/3).<sup>501</sup> In the letter of 19<sup>th</sup> May 1803 he also debates with Strutt the impact of the failure of a

single iron pillar on the supported arches and in this case, as he frequently does, supports his comments with a great deal of empirically-obtained data.

In an earlier undated letter which, based on embedded references, probably originated around the beginning of that year, he advises Strutt of his experiments with flanged iron beams as support to masonry arches and declares that;

The final arrangement of our plans is delayed till we have your approbation or censure, and therefore if a few lines in the course of a post or two would not be inconvenient, I should esteem them a favour. In a short time afterwards, I hope to pay my respects to you in person in my way to Leeds.<sup>502</sup>

The period coincides with the construction of a new mill by Bage and the Benyons for their prospective new partnership, at Meadow Lane, Leeds which Skempton maintains is the first recorded inclusion of iron roof trusses.<sup>503</sup> It seems that Strutt was persuaded by Bage's arguments and his new mill, Belper North, completed in 1804, also incorporated iron beams and trusses, as did the Benyon and Bage mill at Castlefields, Shrewsbury which was likewise

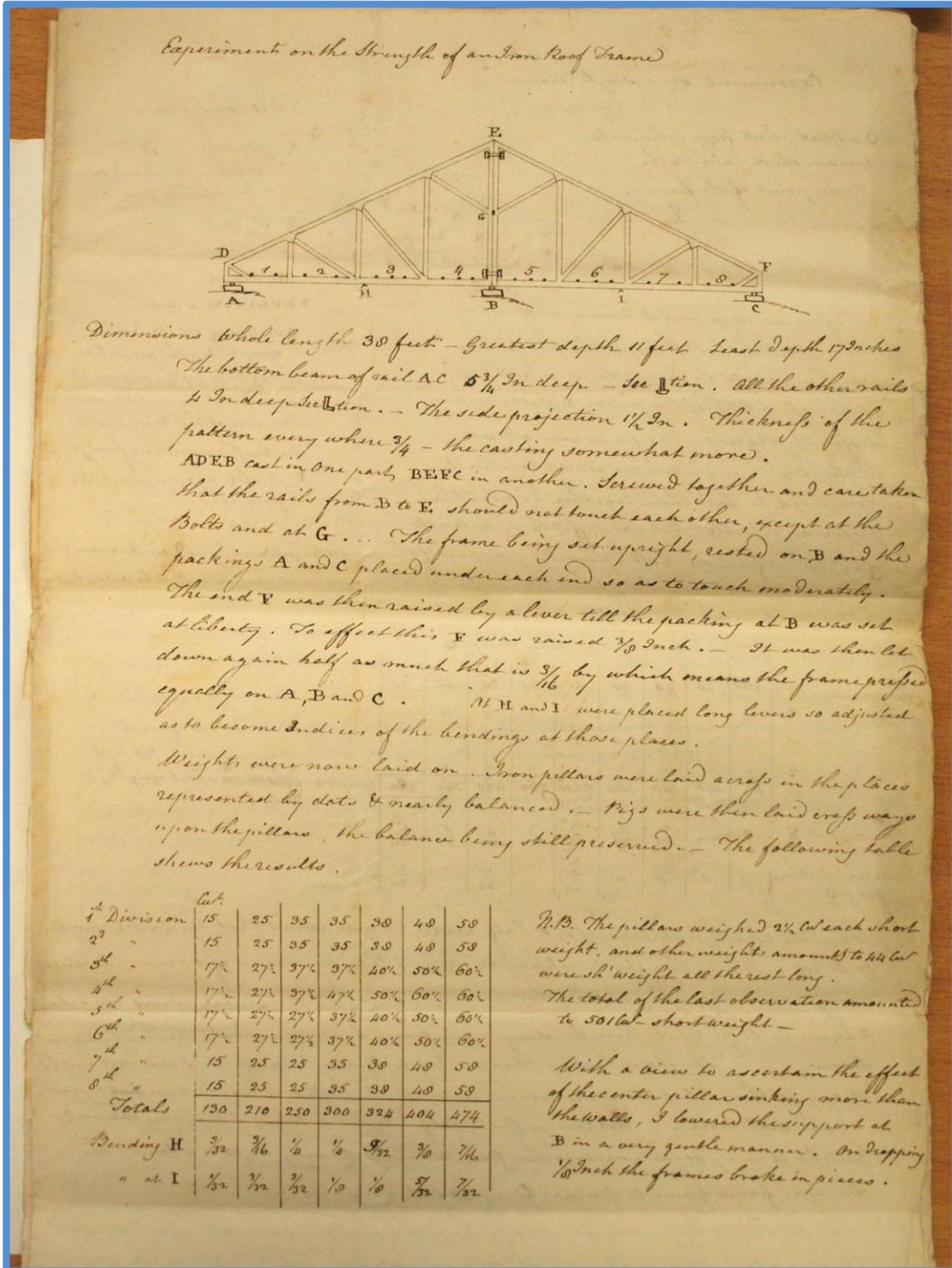
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<sup>500</sup> Shropshire Archives., Ref: 6001/2657/30, Letter written by Charles Bage of Shrewsbury to William Strutt of Derby, 27 Sept 1814.

<sup>501</sup> Shropshire Archives., Ref: 6001/2657/9, 14, 13, 15, 12, Letters and designs written by Charles Bage of Shrewsbury to William Strutt of Derby, 19 May & 29 August 1803.

<sup>502</sup> Shropshire Archives., Ref: 6001/2657/16, Letter written by Charles Bage of Shrewsbury to William Strutt of Derby, undated but probably Dec/Jan 1803.

<sup>503</sup> Skempton, A. W. and Johnson, H. R., 'The first iron frames,' *Architectural Review* (Manchester, 1962), pp. 175-186, p.185.



'Experiments on strength of iron frame roof,' Supplement to letter from Bage to Strutt, dated 29 Aug 1803,

finished in 1804.<sup>504</sup> Trinder notes the period following the construction of Ditherington Flax Mill as having seen the erection of other iron-framed mills in Salford, Dundee and Aberdeen, amongst others. Bage's development of a beam design hypothesis based on a rational methodology established "a process which led to a standardisation of cast-iron beam design by structural engineer, Eaton Hodgkinson in 1830."<sup>505</sup> Trinder also believes that the design of Kingsland mill, built after his separation from the Benyons in 1815, and the speed of construction of Ditherington, testifies to the view that "his understanding of masonry vaults was as significant as his knowledge of the structural properties of iron."<sup>506</sup> Given the apparent deficiency in his knowledge of these areas in 1796, the information garnered, debates enjoined and experimentation undertaken, as documented by his correspondence with Strutt, reveals a significant process of knowledge acquisition over a twenty year period after the beginning of his involvement with Ditherington Flax Mill.

In 1810 and 1811 Bage wrote to Strutt about installing temperature control within an area of the mill and produced a plan for utilising zinc wires to control a damper. He asked Strutt to advise on the expansion and welding characteristics of zinc: in the second letter he included a sketch of his wiring configuration: in the third he confirmed that he has not tried the experiment due to the wire proving not to be significantly expansile; and in the last, reported having being deterred from adopting Strutt's alternative method because of perceived difficulties.<sup>507</sup> By comparison in a later correspondence he discussed at length with Strutt the means of automatically counting the strokes of the engine, or the revolutions of the fly-wheel, which was associated with his attempts to design a power loom for weaving linen. He requested Strutt to engage John Whitehurst, a member of the Derby Philosophical Society and

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<sup>504</sup> Skempton, A. W. and Johnson, H. R., 'The first iron frames,' *Architectural Review* (Manchester, 1962), pp.175-186, p.185.

<sup>505</sup> Trinder, B., 'Ditherington Flax Mill, Shrewsbury- A re-evaluation,' *Textile History*, 23 (2) (1992), pp. 189-223, p. 215.

<sup>506</sup> Trinder, B., 'Ditherington Flax Mill, Shrewsbury- A re-evaluation,' *Textile History*, 23 (2) (1992), pp. 189-223, p. 215.

<sup>507</sup> Shropshire Archives, Ref: 6001/2657/23, 38, 26, 27, Letters written by Charles Bage of Shrewsbury to William Strutt of Derby, undated (probably pre 3/4/1810, 3 April 1810, 24 Jan 1811, April 1811.

son of the former Lunar Society associate, to give it his consideration. He set out in the following three letters a very detailed explanation of why Strutt's suggestion is incorrect and laid out in tabular form 'one hundredth part of the figures I have made on the occasion.'<sup>508</sup>

Although in some respects Bage may be considered to be an empiricist, in as much as observation, experimentation and detailed recording of results formed the basis of the hypotheses he formulated, much of his pursuit of knowledge centred on enquiry of other sources: individuals who may serve his purpose, like Strutt, Reynolds or Samuel Clegg, the former Boulton and Watt apprentice and gas engineer, or from published works such as William Henry's *Chemistry*.<sup>509</sup> But the influence of Ditherington, whatever the proportionate contribution of Bage and Strutt to its final configuration, ensured that Bage's reputation would for a time be enhanced. In 1801 his acquaintance Thomas Telford identified him as one of a group of people sufficiently knowledgeable about the structural characteristics of iron to give opinions on Telford's design for a new London Bridge that were carried forward to the Parliamentary Select Committee on the improvement of the Port of London.<sup>510</sup>

For the purposes of this study he offers an insight into the nature of contemporary knowledge acquisition and transmission within the region. But if Bage had such a fertile mind as has been supposed, based on Hutton's assertions, it remains unclear why he was content to earn a living as a surveyor and wine-seller until he was forty-four years old; why there had been no obvious displays of his intellectual influence or the pursuit of affluence that his contacts within Shrewsbury and Derbyshire may have afforded. It may of course have been that his income was sufficient to allow the furtherance of an interest in natural philosophy and the

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<sup>508</sup> Shropshire Archives, Ref: 6001/2657/22, 20,21, 28, Letters written by Charles Bage of Shrewsbury to William Strutt of Derby, June 1816, 14 July 1816, Undated (after 14/7/1816), 25 Feb 1818.

<sup>509</sup> Shropshire Archives, Ref: 6001/2657/22, 20,21, 28, Letter from Charles Bage to William Strutt, 3 Apr 1810-Ref: 6001/2657/38; Henry, W., *A general view of the nature and objects of chemistry and its applications to Arts and Manufactures*, (1799) referred to in, Letters from Charles Bage to Wm Strutt -5 March 1808- Ref: 6001/2657/35;

<sup>510</sup> House of Commons Parliamentary Papers, <http://parlipapers.chadwyck.co.uk>, *Report from the Select Committee upon the Improvement of the Port of London*, June 1801; Skempton, A. W., 'Telford and the design for a new London Bridge,' in Penfold, A. (ed.), *Thomas Telford, Engineer* (London, 1980).

simple response to such speculation is that from 1796 he did just that. His term of office from 1784-1787 as one of the original directors of the Shrewsbury House of Industry has been considered as verification of his humanitarian credentials, but the principal motivation for the establishment of the Shrewsbury Incorporation for the operation of the House of Industry was driven by the escalating cost of the provision of poor relief. Isaac Wood a later director wrote:

...The rapid and alarming increase of the Poor's Rates in this as in other great towns, at length became a subject of general disquietude...whilst the poor are supported in idleness, they will be averse to labour and the indolence thus encouraged is the fruitful parent of that debauchery and depravity, and that consequent wretchedness and misery, which have made so fatal a progress among the lower orders of the community.<sup>511</sup>

In practical terms the local Act brings the provision of relief for the poor of five parishes in Shrewsbury plus Meole Brace, under the umbrella of a single institution. The preamble declares that the poor of those parishes are numerous and maintained 'at a great and burdensome expense.'<sup>512</sup> It considers that better assistance to the aged and infirm would be afforded, and employment opportunities both to the able and unwilling would result in the poor being able to contribute to their own sustenance rather than being solely dependent on public support. Bage is an encumbered rate-payer and is taking on civic responsibilities in becoming a director of the House of Industry, as he was when elected mayor in 1807. This is not to deny that such roles afforded the opportunity to engage one's moral values in the service of the needy but should not be taken as evidence of such commitment in their fulfilment.<sup>513</sup> In 1812 he admits to Strutt to an involvement in the establishment of a

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<sup>511</sup> Wood, I., 1791, *Some Account of the Shrewsbury House of Industry, its establishment and regulations; with hints to those who may have similar institutions in view* (Shrewsbury, 1791), pp.1-2.

<sup>512</sup> Shropshire Archives, Ref P186/L/1/1, An Act for the better relief and employment of the poor belonging to several parishes within the town of Shrewsbury and the Liberties thereof, in the county of Salop (1784).

<sup>513</sup> 'A correct alphabetical list of the burgesses who voted...at the election for the Borough of Shrewsbury... May 30, 1796', <http://search.ancestry.co.uk>;

Lancasterian School in Shrewsbury which may be a late flowering of social awareness, as seems to have been the case with his former partner John Marshall, or possibly a new wife, but documentary evidence does not point to him having been extensively engaged in social improvement initiatives.<sup>514</sup>

In the period from 1796 and for the first two decades of the nineteenth-century Charles Woolley Bage's active engagement in the transfer of knowledge is visible. He consorts with others who in their turn originate and disseminate knowledge for economic advantage and for the greater benefit of society. He seeks and is occasionally successful in carrying forward improvement in established practice or in setting a benchmark for others to follow. That he is not a political or social radical and that frequently there is no apparent success or obvious benefit arising from his experimentation; that lack of visibility before 1796 may lead to speculation over dilettantism or polite engagement in natural philosophy, should not preclude him from inclusion amongst those who may be considered, through their actions, to embody the spirit of Enlightenment in Shropshire.

#### **4.6 Conclusion**

The nature of intellectual activity and the pursuit of improvement within the industrial sphere, represent the focus of this chapter. It reflects upon the extent to which Enlightenment ideals were expressed; the contemporary relationships between science and industry within Shropshire; and the importance of personal association. It considers the extent to which technological innovation in the Severn Valley was the result of intellectual communion; whether a Shropshire enlightenment might be informed by the concept of Industrial Enlightenment; and whether Shropshire enlightenment consisted of a handful of men pursuing

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<sup>514</sup> Letter Charles Bage to Wm Strutt -22nd July 1812-Ref: 6001/2657/29; Rimmer, W. G., *Marshalls of Leeds, Flax spinners, 1788-1886*, (Cambridge, 1960), pp. 215-6; <http://www.Ancestry.co.uk>, Marriage of Charles Bage Esq and Miss Ann Harding, St Chad's, Shrewsbury, 10 Jan 1809.

economic advantage for their own benefit. In dealing with Shropshire and the Industrial Revolution, Trinder comments about the "uneven survival of evidence" which may distort perceptions of the significance of individuals in the broader progress of economic development.<sup>515</sup> As ever the results of research are conditioned by the contemporary material available and caution is exhibited in the conclusions expressed on the basis of extant evidence that is inevitably deficient.

Joel Mokyr defines his concept of an Industrial Enlightenment as the search for better understanding of how particular processes functioned or situations prevailed in the period leading up to, and during, Industrial Revolution. It precipitated the refinement and extension of the knowledge-base utilised by philosophers and mechanics. It was also characterised by the fostering of close relationships between those who pursued understanding and the men who developed the means of translation of knowledge into productive output.<sup>516</sup> In some instances the same men involved themselves in both roles.<sup>517</sup> The functionality described by Mokyr is, however, too rigid to accommodate much of the innovative investigation conducted by eighteenth-century manufacturers. He determines that innovation arose from understanding the underlying chemical or physical processes, which was a consequence of the broadening of the knowledge-base, but in an industrial environment many of the new processes and engineered solutions developed from empirical trials. A further variant factor that emerges from a micro-study such as this is the influence of local circumstance. Comparative studies relating to industrial and county towns were discussed and drew attention to distinctions in local science cultures or topographies which conditioned the manner of uptake of industrialisation. It is an issue that is revisited in respect of other aspects of the contemporary

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<sup>515</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p.83.

<sup>516</sup> Mokyr, J., *The gifts of Athena* (Princeton, 2002), p. 35.

<sup>517</sup> Peter Jones offers examples within the West Midlands region with regard to the *savants-fabricant* allied to Soho. Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009).

Shropshire social structure. In his later work Mokyr reflected the importance of applied science to the considerations of Industrial Enlightenment and examples of the engagement of Shropshire industrialists in scientific activity and with scientists are noted here.<sup>518</sup>

Considerable focus rested upon William Reynolds and it may justifiably be claimed that he was the nearest thing to a *savant-fabricant* in the East Shropshire Coalfield.<sup>519</sup>

Technological innovation that originated or was adopted within Shropshire owed much to engagement in intellectual communion: Charles Bage was dependent upon his correspondence and visits with William Strutt to inform his experimentation with structural ironwork; William Reynolds' engagement on matters of science and 'mechanics' brought him into contact with many of the leading engineers of the late eighteenth century; John Wilkinson's pursuit of commercial advantage was conducted not only through extensive experimentation but by collaboration and an active role in the dissemination of knowledge. Hayman concluded that a "collaborative culture" persisted in the functioning of forges that drove improvement in techniques, but the absence of specific examples of the artisanal contribution to advances, renders it difficult to assess the true worth of their role in improvement and Industrial Revolution. Although this study has a regional focus, the flow of knowledge that influences or arises from innovation is not constrained by those same geographical boundaries. Some may be conditioned by local practice and local connections, but the existence of networks of intellectual activity determine that knowledge was being transmitted between people over variable distances as well as accumulated from empirical or textual sources.

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<sup>518</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009), p. 140.

<sup>519</sup> Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009), pp. 17-18.

There is little evidence of the industrialists of Shropshire engaging in membership of formal institutions to any degree. Freemasonry lodges which were, on the face of it, centres of egalitarian assembly and offered the prospect of discourse on matters of mutual interest, were supportive of Enlightenment ideals but did not, on current evidence, offer the ironmasters and engineers a forum to which they were attracted. Other than John Wilkinson and Abraham Darby III, there is no industrial membership of the Society of Arts from the county and unlike a number of the major industrial towns there was no Philosophical Society where notions of science could be aired by those active in its pursuit until the 1830s. If a ‘science culture’ prevailed in Shropshire then it had a different form to other regions advancing the cause of industry.

Assessment of the development of Shropshire industry as a ‘progressive and reforming force,’ is more problematic.<sup>520</sup> The achievements of ironmasters and entrepreneurs in the second half of the eighteenth-century are notable for opening the door for much of the industrial development that followed. Consideration of that transformation in the context of wider economic welfare, which would seem a more enlightened ideal, however, requires further evidence-based discourse in the other substantive chapters. From an industrial perspective there is testimony of assistance to the poorer section of society in times of hardship but more constantly with the provision of secure employment arising out of business success. Such an attainment may be incidental to the foremost motivational imperative for many of the industrialists, that of achieving success, economically and socially. Samuel More’s journal entry certainly alludes to such a state concerning his friend John Wilkinson. The dynamic of economic development in Shropshire changed as the nineteenth century progressed. Cyclical fluctuations in the iron industry followed the peace of 1815 and the business models of many

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<sup>520</sup> See Kramnick this thesis p. 27.

of the iron and mineral extraction companies changed, as did the ownership of some of them.<sup>521</sup> Joel Mokyr's assessment of the progress of Industrial Revolution determines that with the broadening of the knowledge-base following innovations and scientific progress of the eighteenth century, continuous technical development and new areas of innovation provided impetus to the Industrial Revolution and sustainable economic growth in the nineteenth-century.<sup>522</sup> Several of the larger Shropshire-based companies continued organic growth in the first half of the century but did not keep pace with the rate of growth in other industrial centres, added to which the locus of innovative activity, both geographic and industrial, shifted.<sup>523</sup> New processes were being adopted in the ironworks in the nineteenth century but none of significance originated in Shropshire. Trinder comments on the departure from Shropshire of skilled men and opportunistic businessmen to South Wales and the Black Country and notes that there were "few positive advantages to ironmasters after 1815" of plying one's trade in the East Shropshire Coalfield.<sup>524</sup> But such emigration was nothing new; the South Wales iron industry had been established largely on the efforts of artisans and ironmasters re-locating from Shropshire in the eighteenth century.<sup>525</sup> What had changed, apparently, was that the coalition of economic opportunity and cultural ethos that had inspired progressive change in the eighteenth-century had ceased to function.

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<sup>521</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p. 113;

<sup>522</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009), p.85.

<sup>523</sup> For example Old Park, Coalbrookdale and Lilleshall Company; Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p.113; Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009), p.84.

<sup>524</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p.134.

<sup>525</sup> Trinder, B., *The Darbys of Coalbrookdale*, Phillimore (London, 1981), p. 41; Hayman, R., *The Shropshire Wrought-iron industry c1600-1900*, Unpublished PhD thesis, University of Birmingham, 2003, p. 90.

## Chapter 5: Agricultural Improvement

### 5.1 Introduction

William Marshall (bap. 1745-1818), the writer and advocate for agricultural improvement wrote that there was no power or legal means, other than by special acts of Parliament that could compel the enhancement of property without the consent of the owner:

And even these are confined to a few particular objects; as drainage, inclosure and the consolidation of intermixed lands; and these, only, where a plurality of interests are concerned... A proprietor may suffer his estate to lie waste, with impunity; provided he thereby injures no man's private property.<sup>526</sup>

In Chapter 2, attention was drawn to the association between agriculture and the notion of 'improvement' as a cultural concept, dating back to the sixteenth-century. In this chapter that relationship is examined in the contexts of Enlightenment and the dissemination of agricultural knowledge in the late eighteenth and early nineteenth-centuries. In doing so it compares the state of agricultural development in Shropshire during this period with the situation that prevailed in other areas of the country. The adoption of new methods of cultivation and husbandry, crop varieties and livestock breeds, as well as selective breeding, was uneven across the county and factors that influenced such circumstances are highlighted.<sup>527</sup> The design and manufacture of agricultural implements and machines enhanced the productive capabilities of farmers where they were employed but in many places the onset of their application was slow, frequently reflecting the conservative attitude to change of landowners and their tenants.

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<sup>526</sup> Marshall, W., *On the landed property of England, an elementary and practical treatise* (London, 1804), p. 28.

<sup>527</sup> Baugh, G. C. And Elrington, C. R., *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-23, <http://www.british-history.ac.uk/report.aspx?compid=22844> Date accessed: 11 November 2011; Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 39; Horn, P. 'The contribution of the propagandist to Eighteenth-century agricultural improvement,' *The Historical Journal*, 25,2 (1982), p. 313; 'Report from the Select Committee on Agriculture,' 1833., Evidence of Richard White, 14th May 1833, Question 473, House of Commons Parliamentary Papers, <http://parlipapers.chadwyck.co.uk>

From the middle of the eighteenth-century a new phase of enclosure impelled the process of agricultural improvement in Britain and brought a substantial amount of land into productive use. This was less of a factor in Shropshire than other counties due to an earlier stage of open-field enclosure. The bringing in to productive capability of former wastes heightened awareness of the efficacy of schemes of drainage and they were employed not just in respect of newly enclosed land but for the alteration of the characteristics of existing farmed land: it changed both productivity and the crop options available to the farmer. This chapter explores how landowners undertook such capital-intensive schemes to improve their estates, seeking to recover their outlay through future rentals. It further considers whether advances in agriculture were contemporaneous with other forms of economic and cultural progress in the Shropshire region at that time. Those who pursued the development of agriculture in this period, either on their own behalf or in the interests of those who engaged them, might be termed ‘the agents of improvement.’ In a region that remained predominantly rural, despite the significant economic advances through industrialisation, the role of major landowners was crucial in the determination of progress of agricultural improvement and the enhancement of net worth of Shropshire property. The degree to which the owners of Shropshire property were ‘absentees’ or not normally resident, cannot be ignored and in such instances, the equally influential role of agents or stewards, acting on their behalf is considered. In doing so the study addresses the issue of whether agents were the determinants of improvement or merely the facilitators. A case study of James Loch, the agent to the Marquis of Stafford (later Duke of Sutherland) illuminates the activities of this body of men.

The emergence of a movement in eighteenth-century Britain, focussed upon the advancement of agricultural methods and understanding, gave rise to ‘changes of consequence’ in the

period between 1750 and 1850.<sup>528</sup> That movement was for the greater part informally organised, although over time bodies emerged on a local and national level that promoted the cause of agricultural improvement: for example the Board of Agriculture, the Royal Agricultural Society of England and local agricultural societies and farmers' associations. As a consequence the chapter addresses the manner in which the knowledge of new methods was disseminated and the importance of the role of agricultural networks. Utilisation of the increasing availability of printed sources for the imparting of knowledge and transmission of experiences took place, which included journals, treatises, and the Board of Agriculture's published series of 'General Views' of the agriculture of each of the counties of Great Britain. The practice of emulation amongst farmers and landowners was promoted and likewise a sense of fashion for improvement amongst members of the landed gentry. A factor for many was economic inducement. Growing markets provided a demand for produce and the progressive improvements in transport infrastructure afforded the opportunity to move farming output more quickly and across greater distances.<sup>529</sup> But as shown in Chapter 3 such developments were slow to evolve and were not applied with any uniformity until well into the nineteenth century. Unevenness in the spread of agricultural knowledge and the adoption of new methods were conditioned by a variety of factors: a conservative approach to change by landowners and farmers; financial constraints imposed by land tenure; and local soil and weather conditions, all inhibited momentum. The influence of such constraints upon the process of local agricultural change is studied here in respect of Shropshire.

As with many rural areas, farming in Shropshire has been conditioned by the variability of its topography, geology and meteorology and it took the evolution of new methods, equipment and above all knowledge, particularly in the late eighteenth and nineteenth centuries, to

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<sup>528</sup> Mingay, G. E. (ed.), *The Agrarian History of England and Wales, Vol. VI, 1750-1850* (Cambridge, 1989), p. 1.

<sup>529</sup> Perren, R., 'Markets and Marketing,' in Mingay, G. E. (ed.), *The Agrarian History of England and Wales, Vol. VI, 1750-1850* (Cambridge, 1989), p. 216.

overcome or moderate naturally-occurring restrictions. Within the county a major topographical division is effected by the River Severn and its flood plain, with much of the land to the west and south being more than 600 feet above sea level (O.D), and most of that to the north and east being less than 500 feet.<sup>530</sup> Within those divisions there are distinct local characteristics and features that have determined the forms of agriculture and population settlement.<sup>531</sup> The north of the county largely consists of a plain that continues into Staffordshire and Cheshire, the eastern portion of which features light, sandy soils that were suitable for arable agriculture. The more central northern areas, from Market Drayton to Oswestry, contain heavier soil structures but its north-east and north-west has areas of sandy loam. Upon the central region of the plain the variety of soil types are influenced by the rivers, their valleys and flood plains in addition to the geology. They bear alluvial deposits that have attracted farming as far back as the Bronze Age.<sup>532</sup> The Clee and Stretton Hills, Wenlock Edge escarpment and the Clun Forest Mass in the southern part of the county present upland terrain and a range of diverse soils and climatic conditions. Corve Dale, lying between Wenlock Edge and the Clee Hills plateau, has historically provided an appealing location for farming, as have many of the lesser valleys and towards the end of the eighteenth-century it acquired the name of 'The Wheatland' reflecting the preponderance of cereal growing adopted during the Napoleonic Wars.<sup>533</sup> The south-west is a predominantly hilly terrain where traditionally sheep pasturing has been practised and arable farming largely restricted to hay production.

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<sup>530</sup> Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 14.

<sup>531</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844> Date accessed: 1 July 2013.

<sup>532</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844> Date accessed: 1 July 2013.

<sup>533</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844> Date accessed: 1 July 2013.

Rainfall within the county is variable and has greatly influenced the nature of agriculture. The west and south-west of Shropshire has significantly greater volumes of rain than further east and where it encounters heavy clay soils it influences the nature of farming engaged upon it, reducing the impact of fertilisers and manures.<sup>534</sup> Levels of rain of between thirty and forty-five inches per annum were typically experienced in those regions compared to around twenty-five inches on the eastern sandstone areas.<sup>535</sup> That there is a greater local diversity of agricultural conditions than this brief outline can impart gives good reason for caution with regard to generalisations concerning the contemporary state of agriculture, its practice or attitudes of farmers. The declaration by John Bishton (1741-1806), a farmer, estate agent, surveyor and industrialist, concerning, ‘...persons who compose the large majority of the farmers of this county, who I am sorry to say, are bad cultivators in the common method of husbandry,’ is an example.<sup>536</sup> Phillip Dodd concludes that by the end of the Napoleonic War, from 1816, the variety of crops grown across the mid-Shropshire region, suggested that farmers were responsive to variations in soil types and conditions.<sup>537</sup> That demonstrations of the manner in which this was achieved were replicated in other parts of the county during the timeframe of this study reflects on contemporary attitudes to improvement in agriculture and its association with Enlightenment ideals.

## 5.2 Agents of Improvement

The identities of those drivers of improvement and their personal motives for engagement in the field are the subject of much debate in the historiography of agriculture. The proclaimed influence of a handful of high-profile estate owners such the 5<sup>th</sup> Duke of Bedford and Thomas

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<sup>534</sup> Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, pp. 45, 125, 137; Phillips, A. D. M., *The underdraining of farmland in England during the nineteenth century* (Cambridge, 1989), p. 2.

<sup>535</sup> Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, pp. 19, 56.

<sup>536</sup> Bishton, J., *A General View of the Agriculture of the County of Salop: with observations on the means of its improvement* (Brentford, 1794), p. 11.

<sup>537</sup> Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 1

Coke of Holkham has been off-set by counter-claims on behalf of ‘owner-farmers’ with holdings of less than 500 acres.<sup>538</sup> John Beckett, for example, denies the innovative importance of ‘the great landowners’ as a group, arguing the cause of the lesser gentry, estate agents and ‘enlightened tenants.’ However the role of some of the major landowners as figureheads for the agricultural movement gave it social credibility and impetus and in the capital re-organisation of estates, occasioned change.<sup>539</sup> It was a role that Arthur Young promoted in his *Farmer’s Letters*: ‘men of fortune, of education, of a turn of mind that leads to other amusements, cannot be supposed to be connoisseurs in barns and hogsties, ditches and dunghills, or clays and sands’.<sup>540</sup> Major landowners were precipitating shifts in attitudes amongst tenants with regard to trialling of new crop species, techniques and experimentation with livestock breeding.<sup>541</sup> Plymley recorded the offer of prizes for the best turnips by Lord Clive to tenants on his Walcot estate in order to encourage change and Loch introduced a tenants’ association and annual shows at Lilleshall to stimulate emulation.<sup>542</sup>

What emerges is that the nature and process of agricultural improvement had a great deal of individual and local specificity. Some of the major estate owners did involve themselves in the processes of estate management and improvement. David Brown confirms that one of the most distinguished improvers, the 5<sup>th</sup> Duke of Bedford, was the driving force for improvements on his estates, rather than his steward.<sup>543</sup> Locally, the 2<sup>nd</sup> Marquis of Stafford,

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<sup>538</sup> Beckett, J. V., ‘Landownership and estate management,’ in <sup>538</sup> Mingay, G. E. (ed.), *The Agrarian History of England and Wales, Vol. VI, 1750-1850* (Cambridge, 1989), pp. 545-640; Brown, D., ‘Reassessing the influence of the aristocratic improver: the example of the fifth Duke of Bedford (1765-1802),’ *Agricultural History Review*, 47, 11, (1999), pp. 182-195; Pitt, W., *A General View of the Agriculture of Staffordshire*, (London, 1796).

<sup>539</sup> Beckett, J. V., ‘Landownership and estate management,’ in <sup>539</sup> Mingay, G. E. (ed.), *The Agrarian History of England and Wales, Vol. VI, 1750-1850* (Cambridge, 1989), p. 569.

<sup>540</sup> Young, A., *The farmer’s letters to the people of England*, Vol. 1 (London, 1771), pp. 2-3.

<sup>541</sup> Brown, D., ‘Reassessing the influence of the aristocratic improver: the example of the fifth Duke of Bedford (1765-1802),’ *Agricultural History Review*, 47, 11, (1999), pp. 182-195; Loch, J., *An account of the improvements on the estates of the Marquis of Stafford in the counties of Stafford, Shropshire and the estate of Sutherland*, (London, 1820); Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 124.

<sup>542</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 125; Staffordshire Record Office, Ref: D593/L/3/11, *The Marquis of Stafford’s Associated Tenantry for the Improvement of Agriculture*.

<sup>543</sup> Brown, D., ‘Reassessing the influence of the aristocratic improver: the example of the fifth Duke of Bedford (1765-1802),’ *Agricultural History Review*, 47, 11, (1999), p. 183.

upon inheritance of the estates in 1803, set out a detailed plan for their improvement, having had prior experiences of estate management and the application of new techniques on other estates.<sup>544</sup> He was kept abreast of events by his agents and was engaged in decision-making on the management of the estates, despite his lengthy absences.<sup>545</sup> His principal agent, James Loch, advised, for example, of the ongoing trials of Merino sheep on some of the estates and of the advisability of deferring rent payments in the light of prevailing adverse market conditions for grain.<sup>546</sup> By comparison the direct involvement of the large land owners was a feature that widely prevailed in Scotland, and the engagement in improvement activity and change was frequently initiated by the owner.<sup>547</sup>

In terms of context, in Shropshire at the middle of the nineteenth-century there were eight large estates of more than 10,000 acres and 137 estates of more than 1,000 acres, totalling 721,829 acres: this out of aggregate land holdings of 791, 939 acres.<sup>548</sup> There were many estates which, through choice, inheritance and acquisition, or the necessities of owners' other interests, were not occupied by their owners and management was devolved to third parties. The large Newport family estate in Shropshire, amounting to more than 23,000 acres, was inherited around 1808 by the Vane family.<sup>549</sup> Earls of Darlington and later Dukes of Cleveland, whose principal residence remained Raby Castle in county Durham, the political activities and sporting affinities of its successive owners afforded little opportunity for active participation in the management of dispersed estates.<sup>550</sup> However, amongst sizeable Shropshire landowners were a number that bore the epithet of improver, the Earl of Bradford;

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<sup>544</sup> Wordie, J. R., *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982), p. 54

<sup>545</sup> See page 194, for the case study on James Loch.

<sup>546</sup> Staffordshire Record Office Sutherland Collection, D593/1/5/3, *Loch to Lord Stafford, 19 May 1814* and D593/K/1/5/9, *Loch to Earl Gower, 30 November, 1820*.

<sup>547</sup> Devine, T. M., *The Transformation of Rural Scotland: Social change and the agrarian economy* (Edinburgh, 1994), p. 60.

<sup>548</sup> 'Summary of parliamentary returns of land, 1876,' in Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844>

<sup>549</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844>

<sup>550</sup> History of Parliament Online, <http://www.historyofparliamentonline.org>

John Cotes; Edward, Viscount Clive; William Childe; Sir John Hill; Thomas Netherton Parker; William Wolryche Whitmore; Hon. Thomas Kenyon and Hon. R. H. Clive amongst the most prominent.

Evidence in estate archives of the activities of proclaimed improvers is piecemeal and in the absence of supportive personal records, reliance has to be placed upon contemporary narrative references or other sources. Agricultural society documents give evidence of expressions of interest if not confirmation of the degree of direct engagement (Appendix 5/1). In order ‘to excite a Spirit of Improvement,’ in March 1800, the Shifnal Agricultural Society promoted the awarding of ‘premiums for different Kinds of Stock and other improvements in the Farming Line’.<sup>551</sup> The published proposal for the inclusion of parishes within a six mile radius of Shifnal, incorporated a list of sixty-five subscribers as at that date. In addition to some of those named above it included George Forrester, Thomas Whitmore and Robert Slaney, prominent county landowners and William Botfield, John Bishton and his son John, who were noted industrialists. Further research will be necessary to identify many of the subscribers due to the absence of specific estate rentals or references within archive material, but undoubtedly this body included tenant farmers and independent owner-farmers. The Shropshire General Agricultural Society founded in 1810, had a reputation for being more select in its admissions.<sup>552</sup> The report on its show in July 1819, however, represented something different: ‘the agriculturists present were not only those in the first rank in society, but also many a plain practical husbandman.’<sup>553</sup> The Society’s notices and newspaper reports of the shows indicate the social acceptability of its activities and give a view of many whose estates submitted entries for categories in the shows. That the credit was conferred on the estate

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<sup>551</sup> Birmingham Archives and Heritage, *Aris’s Birmingham Gazette*, 3<sup>rd</sup> March 1800.

<sup>552</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844>.

<sup>553</sup> *Shrewsbury Chronicle*, 16<sup>th</sup> July 1819.

owner in most cases does not necessarily indicate the extent of his personal involvement in the production of the show entry but at least it would indicate his acquiescence and desire to be considered as being involved.

Among the subscribers to the societies mentioned there were several members of parliament. It has been argued that the institution of improvement in rural counties was enhanced by the lengthy absence of the Whigs from government, with the ensuing loss of influence and esteem.<sup>554</sup> Consequently success as an agriculturalist was deemed to afford the prospect of approbation and facilitated the implementation of radical ideas otherwise denied. There is no evidence such attitudes predominated amongst Whig members for Shropshire constituencies who are identified as agricultural improvers. There were equally conservative members, such as Robert Henry Clive (1789-1854), who carried that mantle. In terms of agricultural enhancement, major improvements in drainage and adoption of new techniques were undertaken by him on Oakly Park. In 1819 and 1820 he was a committee member of the Shropshire Agricultural Society, which may equally have had social overtones, or have been for the purposes of knowledge acquisition.<sup>555</sup> He was also widely involved in local affairs.<sup>556</sup> Further supportive evidence is needed to determine the nature of his interest but it is possible that it may represent the physical expression of obligation that comes with his social position, rather than any 'spirit of improvement.' Whether his engagement in agricultural improvement was for the greater good, financial benefit or social approbation, Clive was committed to the enhancement of his estate and made substantial financial investments particularly in the period of 'high farming' in the late 1840s and 1850s.<sup>557</sup>

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<sup>554</sup> Brown, D., 'Reassessing the influence of the aristocratic improver: the example of the fifth Duke of Bedford (1765-1802),' *Agricultural History Review*, 47, 11, (1999), p. 194.

<sup>555</sup> Shropshire Archives, Eyton family collection, 665/3/1302 and 1303, *Cuttings from Shrewsbury Chronicle re Shropshire Agricultural Society Annual Show*.

<sup>556</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844>;

<sup>557</sup> Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 197.

William Wolryche Whitmore (1787-1858) was MP for Bridgnorth (1820-1832).<sup>558</sup> An active Whig, he carried the imprint of a progressive. Upon retirement, he continued an interest in science, education and economics, engaging in agricultural experimentation at his Dudmaston estate and reportedly improved conditions for tenants and workers. Richard Lyster (c1772-1819) on the other hand was member for Shrewsbury from 1814-1819 and represented himself as an independent and his voting record largely accords with this stand.<sup>559</sup> He appears as a committee member of the Shropshire General Agricultural Society in 1811 and entered and frequently won premiums at the Society's shows.<sup>560</sup>

John Cotes MP (1749-1821), of Woodcote near Newport was known as a moderate Whig, the Countess Granville describing him as having 'a mania for farming, even to asking the people, rich and poor, whom he meets on the high road to come and look at his wheat, potatoes etc.'<sup>561</sup> Vice-president of the newly established Shifnal Agricultural Society, one of the first two societies in the county, he was prominent in its formation.<sup>562</sup> In 1801 he wrote letters to the Board of Agriculture promoting the utilisation of potatoes as a substitute for a wheat-fallow and as a food for both animals and as a supplement to the diets of the poor.<sup>563</sup> In July 1811 he was appointed to the committee of the Shropshire General Agricultural Society which had been formed the previous year and at the show in October 1811 won the premium for 'the best and cleanest crop of turnips.'<sup>564</sup> Even in a small sample such as included here, different attitudes to agricultural improvement prevailed across the political spectrum: progressive Whigs and political conservatives were both enhancing their estates and it would be an

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<sup>558</sup> Escott, M., *William Wolryche Whitmore (1787-1858)* in Fisher, D. R. (ed.), *The history of Parliament :the House of Commons, 1820-1832* (Cambridge, 2009), accessed <http://www.historyofparliamentonline>.

<sup>559</sup> Thorne, R. G., *Richard Lyster(c1772-1819)*, in Fisher, D. R. (ed.), *The history of Parliament: the House of Commons, 1820-1832* (Cambridge, 2009), accessed <http://www.historyofparliamentonline>.

<sup>560</sup> Staffordshire Record Office, D1287/10/2, *Shropshire General Agricultural Society, premiums for July 1811*; Shropshire Archives, Eyton family collection, 665/3/1302 and 1303, *Cuttings from Shrewsbury Chronicle re Shropshire Agricultural Society Annual Show*,

<sup>561</sup> Escott, M., *John Cotes (1749-1821)* in Fisher, D. R. (ed.), *The history of Parliament:the House of Commons, 1820-1832* (Cambridge, 2009), accessed <http://www.historyofparliamentonline>.

<sup>562</sup> *Aris's Birmingham Gazette*, March 3<sup>rd</sup> 1800.

<sup>563</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 163;

<sup>564</sup> Staffordshire Record Office, D1287/10/2/Q/10, *Shropshire General Agricultural Society; Premiums for October 1811*.

unfounded presumption to claim that the motives were for differing reasons. Equally not all Whigs members of parliament had estate improvement as a priority.

The painting of John Cotes by Thomas Weaver (c1774-1843), dated 1810, shows the MP with his bailiff and two ploughmen (see Image 5/1). The pair of plough horses are harnessed abreast, as opposed to the traditional line of four or five horses, nose-to-tail and reflects the adoption of a technique utilised in the east of England and being assumed at this time in various parts of the country.<sup>565</sup> The painting offered the prospect of enhancement to Cotes' reputation as an improver amongst his contemporaries. The approbation of peers and society generally feature alongside fashionable prescription, expression of Enlightenment ideals or the culture of improvement, as reasons attributed to the pursuit of agricultural improvement by landowners. Sarah Wilmot suggests it marked the social substance of the individual, a badge to be worn with pride.<sup>566</sup> Financial benefits arising from the increased rents that reorganisation provoked; from rising output as a result of adoption of improved methods or as a consequence of the greater volume of land in production following enclosure and drainage schemes; and from the economies of scale accruing from the consolidation or reorganisation of farms, are viewed by economic historians as a major incentive for estate owners to improve. Robert Allen dismisses the notion that any social or cultural determination predominated.<sup>567</sup>

For some landowners property enhancement was the means of financing political activity through the ability to extend mortgage debt. Conversely for others the commitment to

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<sup>565</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), p. 161, <http://www.british-history.ac.uk/report.aspx?compid=22844>; Loch, J., *Account of the improvements on the estates of the Marquis of Stafford in Shropshire, Staffordshire and Sutherland*, (London, 1820), App. IX, pp. 86, 88.

<sup>566</sup> Wilmot, S., *The business of improvement: Agriculture, and scientific culture in Britain, c1700-c1870* (Bristol, 1990), p. 44.

<sup>567</sup> Allen, R., 'Agriculture during the Industrial Revolution,' in Floud, R. and McCloskey, D., *The economic history of Britain since 1700*, 3 vols, I, (Cambridge, 2<sup>nd</sup> ed 1994), p. 114. This was also a theme expounded upon by the agriculturalist, Wm Marshall in Marshall, Wm., *On the landed property of England*, (London, 1804), p. 28.

improvement reduced resources available for politics. Although the growing catalogue of study extends knowledge of some of the landed participants in agricultural improvement,

Image: 5/1



Painting of John Cotes by Wm Wood (1766-1826) after Thomas Weaver, with permission of the Yale Centre for British Art, Paul Mellon Collection

there is less clarity over the extent of their direct involvement and their motivation. Bedford himself expressed a sense of obligation following bad harvests and food shortage: 'I consider myself a steward to do the best I can with the money placed in my hands...for the benefit of others...to promote as much general good as possible.'<sup>568</sup> In doing so, he had accumulated unpaid debts of £400,000 by his death in 1802.<sup>569</sup> Coke of Holkham's significance as an improver has been reassessed, with qualification placed on the innovations attributed to him. The role of 'willing tenants' in the development of the Holkham estate has been amplified.<sup>570</sup> Shropshire was not possessed of agriculturalists of such national significance and with a few exceptions the extent to which interest in agriculture represents a 'spirit of improvement' or the expression of Enlightenment ideals is difficult to ascertain with clarity.

The issue of absenteeism on the part of property owners contributed to the inadequate management of some estates, although to a lesser degree than in some areas. It comprised two basic forms: the principal home of the owner, as with the Vane ownership of the Newport estate, lying elsewhere; or the geographical focus for activity, such as career, public service or social and cultural preference taking owners from the principal home for extended periods.<sup>571</sup> Any interest in the furtherance of estate improvement consequently rested on the appointment of competent agents or stewards to manage affairs on behalf of the landowner. In many respects this prospect was not enhanced until the emergence of a professional cadre of men from the middle of the eighteenth-century to fulfil the role.<sup>572</sup> Plymley was forthright in his recommendations that landowners should reside on their estates or in such close proximity as

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<sup>568</sup> Blakiston, G., *Woburn and the Russells* (London, 1980), p. 166.

<sup>569</sup> Brown, D., 'Reassessing the influence of the aristocratic improver: the example of the fifth Duke of Bedford (1765-1802),' *Agricultural History Review*, 47, 11, (1999), p. 183.

<sup>570</sup> Beckett, J. V., 'Landownership and estate management,' in <sup>570</sup> Mingay, G. E. (ed.), *The Agrarian History of England and Wales, Vol. VI, 1750-1850* (Cambridge, 1989), p. 570.

<sup>571</sup> Roebuck, P., 'Absentee Landerownership in the Late Seventeenth and early Eighteenth Centuries: a Neglected Factor in English Agrarian History,' *Agricultural History Review*, 21 (1973), p. 11-12; Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), <http://www.british-history.ac.uk/report.aspx?compid=22844>

<sup>572</sup> Roebuck, P., 'Absentee Landerownership in the Late Seventeenth and early Eighteenth Centuries: a Neglected Factor in English Agrarian History,' *Agricultural History Review*, 21 (1973), p. 16; Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), <http://www.british-history.ac.uk/report.aspx?compid=22844>

would afford their involvement in its control, extolling the benefits that would accrue to the community and themselves.<sup>573</sup> He commented on the degree of change occasioned by the sustained presence of owners in the western parts of the county and drew attention to the developments on Lord Clive's Walcot estate.<sup>574</sup> It is a case that supports Beckett's assertions of the importance of the relationship between owner, agent and tenant whereby a commitment to invest is married to organisation, knowledge and the will to improve.<sup>575</sup>

The influence of the steward or agent became an important constituent in the progress of change in eighteenth and nineteenth-century agricultural development and not uncommonly the motive force for improvement of estates.<sup>576</sup> They played a crucial role in the application and transmission of useful knowledge: their position frequently being independent, they had exposure to other estates or awareness of the practices employed. Loch encouraged farmers upon the estate to visit other farms or work for a period where they might familiarise themselves with different conditions, practices and livestock.<sup>577</sup> The emergence of specialists and assumption of 'professional' competency in the role has been credited with precipitating a decisive change in the management of landed estates.<sup>578</sup> By 1803 Plymley felt it merited recording that in Shropshire, 'several large estates have been materially improved by the

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<sup>573</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 96.

<sup>574</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 125.

<sup>575</sup> Beckett, J. V., 'Landownership and estate management,' in Mingay, G. E., ed., *The Agrarian History of England and Wales*, vol. 6, 1750-1850 (Cambridge, 1989), p. 591.

<sup>576</sup> Mingay, G. E., 'The Eighteenth-century Land Steward,' in Jones, E. L and Mingay, G. E., *Land, labour and population in the Industrial Revolution* (Arnold, 1967), p. 26; 'The Eighteenth-century Land Steward,' in Jones, E. L and Mingay, G. E., *Land, labour and population in the Industrial Revolution* (Arnold, 1967), p. 26.

<sup>577</sup> Staffordshire Record Office, Sutherland Collection, D593/L/4/12, Wm Lewis to Loch, 14 April 1821

<sup>578</sup> Roebuck, P., 'Landownership in the Late Seventeenth and early Eighteenth Centuries: a Neglected Factor in English Agrarian History,' *Agricultural History Review*, 21 (1973), p. 15-16; Beckett, J. V., 'Landownership and estate management,' in Mingay, G. E., ed., *The Agrarian History of England and Wales*, vol. 6, 1750-1850, p. 570; Horn, P., 'The contribution of the propagandist to Eighteenth-century agricultural improvement,' *The Historical Journal*, 25,2 (1982), p. 329.

<sup>579</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 92.

judicious management of land agents by profession; so much so that the face of the county has become quite altered.<sup>579</sup>

On the national stage agents such as Nathaniel Kent and Francis Blaikie established their reputations: Kent significantly in the light of work undertaken for the king and other landed notables and Blaikie in attempting to rescue Coke and the Holkham estate from financial ruin.<sup>580</sup> Kent's 'Hints to gentlemen of landed property' (1775) was to be found in the libraries of Shropshire gentlemen such as Noel Hill of Tern, Rowland Hunt of Boreatton and Abraham Darby III.<sup>581</sup> Whether the opinions were employed or merely polite reading material cannot be determined, given the absence of declared testimonials. Kent was engaged to direct the management of the royal estates of Windsor Great Park and Richmond Park and the independent agency that he and two partners established was widely consulted by landed owners. Lord Anson of Staffordshire and the Earl of Egremont featured amongst his clients and it is claimed that he raised the status of land agency 'to the level of a distinct and honourable profession.'<sup>582</sup> The skills that Rees set forth in 1819 as essential for a steward are extensive, incorporating not only agriculture and land management but awareness of alternative and developing methods, aspects of civil engineering, surveying, financial management and negotiating skills.<sup>583</sup>

The success of agents in promoting improvement in agriculture during the period from the middle of the eighteenth-century must be measured against the prevailing background in which they worked. Arthur Young considered Shropshire to be backward in the application of

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<sup>579</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 92.

<sup>580</sup> Horn, P., 'An eighteenth-century land agent: the career of Nathaniel Kent (1737-1810), *Agricultural History Review*, 30 (1982); Mingay, G. E., 'The Eighteenth-century Land Steward,' in Jones, E. L and Mingay, G. E., *Land, labour and population in the Industrial Revolution* (Arnold, 1967), p.27; Webster, S., Agents and Professionalisation: Improvement on the Egremont Estates, c.1770 to c. 1860, Unpublished PhD thesis (Nottingham University, 2010), p. 201;

<sup>581</sup> Coulton, B., *A Shropshire Squire: Noel Hill, first Lord Berwick, 1745-1789* (Shrewsbury, 1989), p. 56; Shropshire Archives, Ref: 6001/4848 'Catalogue of books at Boreatton 1812,' Ironbridge Gorge Museum Library, Hay Farm Sale Catalogue- re effects of Abraham Darby III- 7th & 8th May 1789.

<sup>582</sup> Horn, P., 'An eighteenth-century land agent: the career of Nathaniel Kent (1737-1810), *Agricultural History Review*, 30 (1982), p. 15.

<sup>583</sup> Rees, A., *The cyclopaedia, or, universal dictionary of arts, sciences & literature* (London, 1819).

new techniques and utilisation of new crop variants or livestock, in comparison to other areas, as did Bishton.<sup>584</sup> However, it takes no account of the degree of variability of conditions in the county, mentioned above or the nature of change that took place in the second half of the eighteenth-century in Shropshire, as discussed later in this chapter. The process of change was undoubtedly slow, owed no little to lack of appropriate knowledge and commitment to improvement being patchy and exhibiting a lack of momentum. In the latter case it was frequently conditioned by the prevailing forms of land tenure where leases were often secured on the term of ‘three lives:’ potentially sixty or seventy years. Young, Bishton and Plymley measured the state of agriculture in Shropshire at different times in the period to the end of the century against the yardstick of the state of farming in Norfolk. In his 1794 *General view of Norfolk agriculture*, Kent suggested that readers should remain open-minded and set aside any prejudices, bearing in mind that, ‘husbandmen are more obstinately attached to old practices, let them be ever so bad, than any other description of men, and are consequently averse to the introduction of any thing new, let it come ever so well recommended.’<sup>585</sup> The actions of the land agents in Shropshire are therefore conditioned by this background.

The role of agent or steward varied with the needs of the estate and its owner. It was often the responsibility of agents to manage the political interests of their employer, as in the case of John Ashby and James Loch. Surveying, management of rentals and legal expertise may be consigned to an independent professional or be part of the agent’s skill-set. Farming or responsibility for the domestic needs of the family may be placed in the hands of functional under-agents. Invariably ultimate responsibility for the satisfactory acquittal of these roles rested with the chief agent. In the eighteenth-century agents with a legal background were frequently employed in the light of perceived priorities of the landowner, for example to

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<sup>584</sup> Young, A. *Tours in England and Wales* (London, 1776), p. xx ; Bishton, J., ‘A general view of the Agriculture of the County of Salop: with observations on the means of its improvement’ (Brentford, 1794), p. 11.

<sup>585</sup> Kent, N., *A General view of the agriculture of Norfolk* (London, 1794), p. 191.

effect acquisition, disposal and exchange of properties and the pursuit of local legislation for enclosure. The separation of roles was occasioned in the case of the brothers Thomas (1720-1798) and John (1723-1795) Gilbert who acted for Earl Gower and was the visible exemplification of the emergence of professional specialisation.<sup>586</sup> Thomas trained as a lawyer and by 1759 was acting as the Earl's political adviser and agent when he took over from Robert Barbor as chief agent.<sup>587</sup> He was also steward to the Duke of Bridgewater, Earl Gower's brother-in-law. His brother John was a businessman who had run the family lime works after the death of their father and was engaged by Thomas to examine the Bridgewater mining operations. He was involved in the design of the Bridgewater Canal for the Duke, together with his neighbour James Brindley, and subsequently Earl Gower's Donnington Wood Canal in Shropshire. Both brothers were management committee members in the Shropshire and Shrewsbury Canals and had major interests in the development of the Gower mineral extraction enterprises at Lilleshall. John was undoubtedly progressive in his approach to change, as witnessed by the improvements wrought to the Bridgewater estates in draining the 6,000 acres of the Chat Moss.<sup>588</sup> It was a policy also employed on the Lilleshall estates for Lord Gower. The brothers successfully managed aspects of the Gower interests but they were not farmers or men with any apparent interest in agricultural improvement certainly as far as it affected the Gower estates. The constraints placed on the ability of the landlord to enforce farming change on his tenants by the form of the estates' farm tenure policy, however, have to be acknowledged.

John Ashby (1722-1779) was someone who tried to address such issues in his role as the agent for the Clive and Forester families from 1769 to 1779. Having established a successful

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<sup>586</sup> Lead, P., *Agents of Revolution: John and Thomas Gilbert- Entrepreneurs*, Staffs Heritage Series, Vol 2 (Keele, 1992), p. 14.

<sup>587</sup> Wordie, J. R., 1982, *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982), p. 45.

<sup>588</sup> Lead, P., *Agents of Revolution: John and Thomas Gilbert- Entrepreneurs*, Staffs Heritage Series, Vol 2 (Keele, 1992), p. 34.

legal practice in addition to a significant civic presence for himself, he was well-placed to deal with the demands of managing Clive's Shropshire interests. He had been mayor of Shrewsbury in 1759 and was appointed town clerk in 1767. He also served three times as Deputy Sheriff of Shropshire in support of members of the gentry holding the Sheriff's office and was therefore very well-connected. The estates had been acquired by Clive primarily for the political influence they afforded and as agent Ashby was responsible for the management of those political interests. He performed a similar role for the Foresters with regard to their Much Wenlock interests.<sup>589</sup> Where Ashby differed from the Gilbert brothers as far as estate management was concerned, was that he was a 'progressive and radical figure,' his views possibly influenced by the works of Locke, Montesquieu and Voltaire noted in his probate inventory.<sup>590</sup> Together with his assistant John Probert, he reorganised the Clive estates, arranging property exchanges with other landowners to accommodate a rationalisation of farm layouts.<sup>591</sup> They negotiated with tenants for the revision of lease terms and conditions in return for which the landlord committed to substantial investment in drainage and lime fertilisation.<sup>592</sup> As part of a process to overcome any natural resistance by tenants to adoption of alternative forms of husbandry, crops and livestock breeds, the award of prizes was instituted, including a silver trophy for turnip growing.<sup>593</sup> Some thirty years later Plymley commented on the current practice employed upon the Clive estates of encouraging tenants in the cultivation of turnips 'by the annual distribution of six silver cups.'<sup>594</sup> It seems to have been an initiative sustained by dint of finding favour with tenants, but whether progress

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<sup>589</sup> Nichol, J. D., 'Social life and political stability in 18th century provincial life. A study of the career of John Ashby (1722-1779) of Shrewsbury,' *Transactions of the Shropshire Archaeological and history Society*, 59 (1969-70), p. 56;

<sup>590</sup> Nichol, J. D., 'Social life and political stability in 18th century provincial life. A study of the career of John Ashby (1722-1779) of Shrewsbury,' *Transactions of the Shropshire Archaeological and history Society*, 59 (1969-70), p. 60.

<sup>591</sup> Nichol, J. D., 'Social life and political stability in 18th century provincial life. A study of the career of John Ashby (1722-1779) of Shrewsbury,' *Transactions of the Shropshire Archaeological and history Society*, 59 (1969-70), p. 59.

<sup>592</sup> Nichol, J. D., 'Social life and political stability in 18th century provincial life. A study of the career of John Ashby (1722-1779) of Shrewsbury,' *Transactions of the Shropshire Archaeological and history Society*, 59 (1969-70), p. 59; National Archives, C, 109/74, J. Ashby to J. Probert, 15 December 1770.

<sup>593</sup> Nichol, J. D., 'Social life and political stability in 18th century provincial life. A study of the career of John Ashby (1722-1779) of Shrewsbury,' *Transactions of the Shropshire Archaeological and history Society*, 59 (1969-70), p. 60.

<sup>594</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 125.

continued following the death of Ashby in 1779 has not yet emerged from research into the extensive collection of Clive papers. Probert, however, continued as agent until 1818.

The adoption of alternative rental arrangements, with shorter duration lease terms or tenure at will, was a policy embraced by John Bishton and his sons on the Gower/Stafford estates. It carried a consequential commitment to increased landlord's expenditure on estate development, increased rents and the landlord's determination of the farming policies to be adhered to by tenants.<sup>595</sup> Underpinning this policy was the belief that capital expenditure by the owner would improve the quality of farms and generate sustainable rental income for the future. The benefit to the farmer arose from greater productive output resulting from the amelioration of land quality and improved farming practices. In evidence to the parliamentary Select Committee on Agriculture in 1833 Richard White, agent to R. H. Clive at Oakly Park, considered that such letting policies had proved successful in Shropshire because 'more exertion is required (of the tenant), and then I think the soil is benefited.'<sup>596</sup> As a means of enforcing the farming provisions of the leases Bishton instituted fines for infraction and was prepared to pursue them at law.<sup>597</sup> Loch similarly set out clear instructions as to the practices to be followed and engaged both persuasion and dictate to ensure compliance.<sup>598</sup> In his report on Shropshire for the Board of Agriculture, John Bishton expressed very forthright views on farming, recording his personal utilisation of Norfolk crop rotations and underdraining.<sup>599</sup> It has been assumed that it was the experience of farming his inherited estate at Kilsall that

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<sup>595</sup> Wordie, J. R., 1982, *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982), p. 203.

<sup>596</sup> Evidence of Richard White to Select Committee on Agriculture, 14 May 1833, House of Commons Parliamentary Papers, <http://parlipapers.chadwyck.co.uk>, p. 26.

<sup>597</sup> Wordie, J. R., 1982, *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982), p. 203.

<sup>598</sup> Wordie, J. R., 1982, *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982), p. 203-4; Staffordshire Record Office, Sutherland collection, Chief agent's out letters-1813, D593/K/1/5/2, 'J. Loch to W. Ford 24 Nov 1813' and, D593/K/1/5/4, 'J. Loch to Mr Boycott, 11 Nov 1815;' see case study on Loch, p. 29.

<sup>599</sup> Bishton, J., *A general view of the Agriculture of the County of Salop: with observations on the means of its improvement* (Brentford, 1794), p. 8.

persuaded Earl Gower to appoint him agent.<sup>600</sup> However, he had established himself as a land surveyor and was a partner in a coal and iron enterprise in the Forest of Dean.<sup>601</sup> In 1790s he developed interests in iron and coal within the Shropshire Coalfield and when the Gower estates moved from being ground landlords to active involvement in mining and iron production, Bishton became a major partner in the resulting Lilleshall Company.<sup>602</sup> In his *General View* he wrote of the drainage of part of his own estate and his designing of tiles to accomplish the process and it is significant that amongst the first tasks he addressed upon being first appointed as agent on the Lilleshall estate in 1788, was the drainage of Weald Moors.<sup>603</sup> It would suggest that it was Bishton's drive and abilities generally that attracted Gower, in the light of what the landlord envisaged for his estates, rather than merely his experience as a farmer of some 400 acres.

Whilst a competent agent was essential in the management of country estates, particularly where prolonged owner absence was routine, there is no evidence that some were other than functional servants responsible for passing on the owners' instructions and collecting rent when due.<sup>604</sup> Thomas Bell served the Hill family at Tern Hall and Attingham from 1734 until 1773 but in an agricultural context in those middle years of the century, there would probably have been little expectation of a display of innovation on his part.<sup>605</sup> At Tern between 1770 and 1774 a substantial number of decorative and structural trees were planted.<sup>606</sup> On

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<sup>600</sup> Wordie, J. R., 1982, *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982), p. 55;

<sup>601</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p. 81; Staffordshire Record Office, D1057/G/2/12, *Survey and valuation of Pentrheylin estate...conducted by j. Bishton and C. Bage, 20 June 1788*; Shropshire Archives, 348/10.f33v,43v, *Minutes of meetings of the Commissioners appointed under the acts for building a new Shirehall 1783 and for building a new Gaol and House of Correction 1786*.

<sup>602</sup> Wordie, J. R., 1982, *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982), p. 120

<sup>603</sup> Bishton, J., 'A general view of the Agriculture of the County of Salop: with observations on the means of its improvement', Brentford, 1794), p.17-18; Wordie, J. R., 1982, *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982), p. 201.

<sup>604</sup> Wordie, J. R., 1982, *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982), p. 179.

<sup>605</sup> Thomas Bell, John Probert and Wm Corfield acted as enclosure commissions in respect of the enclosure of Bickton Heath, 9<sup>th</sup> July 1767, *The Law Journal Reports: Monthly list*, 9 July 1767 (Princeton, 1851) online search.

<sup>606</sup> Coulton, B., *A Shropshire squire: Noel Hill, first Lord Berwick, 1745-1789* (Shrewsbury, 1989), p. 32.

inheriting the estate on his marriage in 1768, Noel Hill had determined on the improvement of the house and park. His brother-in-law Henry Vernon had extensively planted trees on his estate at Hilton and Coulton suggests him as the likely source of advice to Hill in this respect, rather than Bell.<sup>607</sup> Given the time needed for maturing of structural trees it displays considerations on the part of Hill and Vernon for the interests of future generations and income production. Sir Charles Rouse-Boughton of Downton in the south of the county was an example of an owner who spent most of his time away from the estate and the content and regularity of correspondence between himself and his steward, John Stephens, indicates the degree of detailed control the owner maintained over matters on his estate and the lack of discretion devolving to his steward.<sup>608</sup> Such improvement as was deemed necessary was promoted by the landowner rather than the steward. Varieties of seed for trial and trees to plant in a major planting project were even sourced by Rouse-Boughton and despatched to the estate.<sup>609</sup> To overcome the difficulties of absence he had recourse to the services of Robert Tench, a gentleman farmer at Bromfield who offered advice and assisted in matters requiring the intervention of someone of greater social substance than Stephens.<sup>610</sup> As a member of the Shropshire General Agricultural Society and a prize winner at several of the shows, Tench was a competent farmer and a familiar of local agriculturalists such as William Childe and he offered some substance in a role of de facto land agent. He had also made submissions to Plymley on aspects of the state of farming in south Shropshire.<sup>611</sup> That Bromfield lay within the area that had experienced a progressive approach to estate management under the Clive

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<sup>607</sup> Coulton, B., *A Shropshire squire: Noel Hill, first Lord Berwick, 1745-1789* (Shrewsbury, 1989), p. 32.

<sup>608</sup> Shropshire Archives, 6683/3/3/ and 6683/3/27, *Rouse-Boughton Collection*.

<sup>609</sup> Shropshire Archives, 6683/3/27/12, *Rouse-Boughton to Stephens 20 March 1810*.

<sup>610</sup> Shropshire Archives, 6683/3/27/4, *Rouse-Boughton to Tench, 31 March 1810*.

<sup>611</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 162-3.

family since 1770s, gives indications of an established enthusiasm for the advancement of farming within particular communities.<sup>612</sup>

Mingay suggested land agents of great estates were often the ‘driving force,’ in nineteenth-century drainage schemes and farm re-organisation, as they were in enclosure and tenancy variation in the previous century.<sup>613</sup> However, agents were not, as a group, uniquely unimpeachable, as demonstrated at Hawkestone, nor free from ‘obstinate attachment’ to established methods, but where skilled and progressive in their outlook achieved much in the way of agrarian and agricultural change. Examples of progressive agents are identifiable in Shropshire both in the eighteenth and early nineteenth-centuries and in the move towards the adoption of ‘high farming’ practices of the mid-nineteenth-century, their competency and professionalism became more apparent, particularly with the application and promotion of knowledge.<sup>614</sup> But the extent to which they were employed by landowners has yet to be established. During the eighteenth-century agents were frequently engaged because of their legal and management background, as in the case of Thomas Gilbert by Earl Gower and Robert Pemberton in the 1790s at Attingham Park.<sup>615</sup> Where employed, progressive land agents were instrumental in the dissemination of knowledge of new practices and initiated the trial of alternative crops and livestock within the estates.<sup>616</sup> Some like Kent and Marshall resorted to publication of their experiences but in most cases it was the encouragement of emulation, provision of access to published material and the establishment of the means of congress such as provided by home farms, societies and clubs and periodic shows that

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<sup>612</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), eg. pp. 102, 158, 174.

<sup>613</sup> Mingay, G. E., ‘The Eighteenth-century Land Steward,’ in Jones, E. L and Mingay, G. E., *Land, labour and population in the Industrial Revolution* (Arnold, 1967), p. 26.

<sup>614</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844>

<sup>615</sup> Lead, P., *Agents of Revolution: John and Thomas Gilbert- Entrepreneurs*, Staffs Heritage Series, Vol 2 (Keele, 1992); Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844>

<sup>616</sup> See case study of James Loch, p. 194.

encouraged tenant farmers to adopt new practices. The experimentation and livestock improvement undertaken at Walcot Hall in the period from the 1790s until the end of the Napoleonic war was, for example, reflected in the improving activities of farms in the immediate region and therefore bears the imprint of Lord Clive and his agent John Probert.<sup>617</sup>

### 5.3 Knowledge dissemination

Furtherance of awareness of improved husbandry went beyond the intercessions of land agents. The growth in the volume of agricultural publications witnessed in the eighteenth-century gives testimony to enthusiasm that existed for agrarian reform and improvement: pamphlets, newspapers, periodicals, books and encyclopaedia dedicated to agriculture, recorded experiences and offered advice.<sup>618</sup> In the cultural climate of the time, the thirst for knowledge and the promotion of improvement pervaded all classes and social groupings: farmers and landed property owners being as likely to succumb as ‘the urban and industrial bourgeoisie.’<sup>619</sup> However the acquisition of printed material by agriculturalists was undoubtedly conditioned by issues of accessibility, cost and levels of literacy.<sup>620</sup> During the century to 1800 there were 223 towns in Britain for which there are recorded imprints of printers on published works.<sup>621</sup> The number of towns with booksellers would greatly exceed that. In Shropshire some 120 booksellers have been identified during the period.<sup>622</sup> On a local level much of their output was in the form of pamphlets, which covered a wide range of subjects including religious tracts and debate on social and political issues but also afforded the opportunity for the recording of agricultural experiments and treatises. William Wolryche

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<sup>617</sup> Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 45.

<sup>618</sup> Goddard, N., ‘Agricultural literature and societies,’ in Mingay, G. E. (ed.), *The Agrarian History of England and Wales, Vol. VI, 1750-1850* (Cambridge, 1989), pp. 361-370; Holmes, H., ‘The circulation of Scottish agricultural books during the eighteenth century,’ *Agricultural History Review*, vol. 54, 2006, pp. 45-78.

<sup>619</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009), p. 186;

<sup>620</sup> Holmes, H., ‘The circulation of Scottish agricultural books during the eighteenth century,’ *Agricultural History Review*, vol. 54, 2006, p. 59.

<sup>621</sup> Mitchell, C. J., ‘Provincial printing in eighteenth-century Britain,’ in *Publishing History*, 21, 1987, p. 18.

<sup>622</sup> See Chapter 5.

Whitmore MP wrote on the economics of contemporary agriculture. He also penned a number of treatises on the issue of protectionism and the Corn Laws, in the form of letters to the agriculturalists of Shropshire.<sup>623</sup>

By comparison in Edinburgh between 1740 and 1778 the number of printers increased from four to twenty-seven and the city became a major book publishing centre, second in Britain only to London, in terms of titles.<sup>624</sup> Consequently much of the published work relating to Scottish agriculture during the period, originated with Edinburgh publishers. It was a reflection of the state of Scottish agriculture in the eighteenth-century and enthusiasm for its improvement in the lowland areas of the country. Adam Smith (1723-1790) and Henry Home, Lord Kames (1696-1782) were amongst those Scottish intellectuals who expressed particular interest in agricultural improvement.<sup>625</sup> Edinburgh, and Dublin, aside, the scale of printing within the regional towns was of a more modest order and whilst local booksellers were available to service orders, books were frequently acquired through subscription or from London, particularly by those with homes or contacts in the capital.<sup>626</sup> In recommending a selection of books to his son, the civil engineer Matthew Davidson promised: ‘When Playfair publishes his Huttonian Theory there shall a copy be ordered at London and sent to you at Oswestry.’<sup>627</sup>

Books were often targeted at particular readerships: Kames declared *The gentleman farmer* (1776) to be ‘intended chiefly for the gentlemen of land estates,’ Richard Parkinson, directed

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<sup>623</sup> Wolryche Whitmore, W., *A letter on the present state and future prospects of agriculture. Addressed to the agriculturalists of the County of Salop* (London, 1822); *A letter to the agriculturalists of the County of Salop, 5<sup>th</sup> June 1841* (London, 1841); *A second letter to the agriculturalists of the County of Salop, 5<sup>th</sup> August 1841* (London, 1841); *A third letter to the agriculturalists of the County of Salop, 24<sup>th</sup> January 1846* (London, 1846).

<sup>624</sup> Holmes, H., ‘The circulation of Scottish agricultural books during the eighteenth century,’ *Agricultural History Review*, vol. 54, 2006, p. 52; Mitchell, C. J., ‘Provincial printing in eighteenth-century Britain,’ in *Publishing History*, 21, 1987, p. 18.

<sup>625</sup> Devine, T. M., *The Transformation of Rural Scotland: Social change and the agrarian economy* (Edinburgh, 1994), p. 65.

<sup>626</sup> Holmes, H., ‘The circulation of Scottish Agricultural books during the eighteenth century,’ *Agricultural History Review*, Vol 54, 2006, p. 53.

<sup>627</sup> Ironbridge Gorge Museum Library, DMD8-Acc No 1992.14918, *Matthew Davidson correspondence; copy letter book 1795-1818, Matthew Davidson to Thomas Davidson 14<sup>th</sup> April 1812*. He was referring to *Illustrations of the Huttonian theory of the Earth* by John Playfair (1748-1819), which explains James Hutton’s geological theories.

his book to 'the practical farmer.'<sup>628</sup> They dealt with different aspects of farming including techniques, livestock, implements and agricultural tours: others were encyclopaedia. The books, not unexpectedly, had a variable quality of content with publishers recycling material in different forms to meet the demands of a burgeoning market.<sup>629</sup> With little practical experience of the subjects about which they wrote some writers were criticised for the detrimental influence they had on the whole genre: others brought a background and knowledge of farming to authorship and consequently acquired the approbation of the reading public.<sup>630</sup> Young, Marshall and Kames all validated their narratives on the strength of personal agricultural experiences and enjoyed notable success and reputations. Few of the books published before the middle of the nineteenth-century, however, had scientific substance to their assertions and recommendations, although a Shropshire resident of the time, the 9<sup>th</sup> Earl of Dundonald, wrote a treatise in which he gave a detailed exposition of the nature and characteristics of chemical elements and compounds and their effects on manure and agricultural processes.<sup>631</sup> Consequently there was little understanding of why particular outcomes arose, only that, based on experimentation, in certain circumstances they did.

Whilst the opportunity existed for Shropshire farmers and landowners to acquaint themselves with current agricultural thinking, it is difficult to verify the extent to which they availed themselves. The presence of improving texts in the libraries of landed gentlemen is not necessarily evidence of their employment in the enhancement of their estates and farms but

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<sup>628</sup> Parkinson, R., *The experienced farmer, an entire new work* (London, 1798).

<sup>629</sup> Kames, Home, H. Lord, *The gentleman farmer, being an attempt to improve agriculture, subjecting it to the test of rational principles* (Edinburgh, 1776), p. vii.; Holmes, H., 'The circulation of Scottish agricultural books during the eighteenth century, *Agricultural History Review*, vol. 54, 2006, p. 68.

<sup>630</sup> Goddard, N., 'Agricultural literature and societies,' in Mingay, G. E. (ed.), *The Agrarian History of England and Wales, Vol. VI, 1750-1850* (Cambridge, 1989), p. 361; Anderson, J., *Essays relating to agriculture and rural affairs* (Edinburgh, 1775 edition), p. vii; Holmes, H., 'The circulation of Scottish agricultural books during the eighteenth century, *Agricultural History Review*, vol. 54, 2006, p.65.

<sup>631</sup> Goddard, N., 'Agricultural literature and societies,' in Mingay, G. E. (ed.), *The Agrarian History of England and Wales, Vol. VI, 1750-1850* (Cambridge, 1989), p. 364; Dundonald, Cochrane, A., 9th Earl, 'A treatise, shewing the intimate connection that subsists between agriculture and chemistry' (London, 1795).

does demonstrate the accessibility of useful knowledge.<sup>632</sup> In some cases they may have been accessions to fashion or polite reading matter. *The Farmer's Magazine* drew attention to fashionable interest in agriculture: 'a gentleman would now be looked upon as a ninny who could not in some degree join in a conversation upon agricultural subjects'.<sup>633</sup>

The prices of books reflected their size and the materials of which they were constructed.<sup>634</sup> Folios were more expensive than duodecimos; calf bindings more than boards. The quality of paper and printing also varied. While some efforts were made by publishers in the late eighteenth-century to make books more accessible to farmers at the cost of a few pence, the price of duodecimos in the third quarter of the eighteenth-century generally fell within the range of 1s 6d to 3s. Octavos cost between 1s 6d and 13s. Reduced prices were offered to pre-publication subscribers or on occasions to the purchasers of subsequent volumes to editions.<sup>635</sup> But where cost and the means of acquisition of books presented difficulty, access was on occasions afforded by agricultural societies or even the landowner or agent. In a letter to Lord Hardwicke, James Loch reported that the Marquis of Stafford was distributing copies of the books of Sinclair and Brown among his tenants, 'which had been eagerly consumed'.<sup>636</sup> It should be noted, however, that unlike Scotland, many counties in England had few, if any agricultural societies until the nineteenth century; Shropshire acquiring its first two in 1800. Local newspapers and periodicals also printed agricultural discourses. For example, Thomas Netherton Parker's exposition of the types and means of cultivation of potatoes was serialised

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<sup>632</sup> Shropshire Archives, Ref: 6001/4848, Catalogue of books at Boreatton 1812; Ironbridge Gorge Museum Library, Ref. 1979.1068, *A catalogue of all the extensive and capital well-bred farming stock and implements of husbandry belonging to the late Mr Abraham Darby II... 7th & 8th May 1789*.

<sup>633</sup> *The Farmer's Magazine, a periodical work exclusively devoted to Agriculture and Rural Affairs*, 8, 1807, p. 314

<sup>634</sup> Holmes, H., 'The circulation of Scottish agricultural books during the eighteenth century', *Agricultural History Review*, vol. 54, 2006, p.59.

<sup>635</sup> Holmes, H., 'The circulation of Scottish agricultural books during the eighteenth century', *Agricultural History Review*, vol. 54, 2006, p.62

<sup>636</sup> Staffordshire Record Office, Sutherland Collection, D593/K/1/5/4, *Chief agent's out letters- 1815, Loch to Lord Hardwicke, 28<sup>th</sup> March 1815*; Sir John Sinclair (1754-1835), President of the Board of Agriculture and Robert Brown (1757-1831), farmer and agricultural writer.

in the *Salopian Journal*.<sup>637</sup> Local papers printed reports on agricultural shows and premium winners, fostering sentiments of self-worth and ambition and furthering emulation.<sup>638</sup>

Amongst the more long-lasting periodicals, '*Annals of Agriculture*,' published by Arthur Young between 1784 and 1809, had socially respected contributors in the shape of Jeremy Bentham, Joseph Priestley, Thomas Coke and King George III, but had a circulation of only 350 copies per issue.<sup>639</sup> Goddard's view that periodicals such as *Annals* were more accessible and thereby more acceptable to the farming fraternity is based largely on the format and content but accessibility does not necessarily equate to widespread access. Even making allowance for multiple readership through the agency, for example, of the agricultural societies and coffee houses, circulation figures of several hundred copies does not indicate extensive coverage. Landed gentlemen who spent time away from their estates in London would have access to agricultural periodicals and the later newspapers, but for many Shropshire farmers, unless subscribers, they would have been a rarity.

The level of literacy amongst farmers and their capacity to absorb new ideas through written sources has been addressed both by historians and contemporary writers and it remains largely unresolved.<sup>640</sup> Horn makes a blanket assertion that a lack of literacy may have been a determining factor in a lack of uptake of new ideas from written material but makes no allowance for social or geographical variation or timing.<sup>641</sup> Devine on the other hand considers that literacy in lowland areas of Scotland were a positive factor in eighteenth-century improvement.<sup>642</sup> With regard to Shropshire, Loch was clear in his approbation of the

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<sup>637</sup> Parker, T. N., 'Remarks on the Cultivation of Potatoes, with a reasonable probability of the crop being a mealy and excellent quality,' No 6 and last, *Salopian Journal*, 6<sup>th</sup> April 1841.

<sup>638</sup> Shropshire Archives, *Shrewsbury Chronicle*, 19<sup>th</sup> July 1819.

<sup>639</sup> Goddard, N., 'Agricultural literature and societies,' in Mingay, G. E. (ed.), *The Agrarian History of England and Wales, Vol. VI, 1750-1850* (Cambridge, 1989), p. 366.

<sup>640</sup> Horn, P. 'The contribution of the propagandist to Eighteenth-century agricultural improvement,' *The Historical Journal*, 25,2 (1982), p. 322; Devine, T. M., *The Transformation of Rural Scotland: Social change and the agrarian economy* (Edinburgh, 1994), p. 69.

<sup>641</sup> Horn, P. 'The contribution of the propagandist to Eighteenth-century agricultural improvement,' *The Historical Journal*, 25,2 (1982), p. 322.

<sup>642</sup> Devine, T. M., *The Transformation of Rural Scotland: Social change and the agrarian economy* (Edinburgh, 1994), p. 69.

Gower/Stafford tenantry's consumption of supplied texts. By 1700 male literacy rates in Britain have been estimated to have exceeded 50 per cent of the total adult population and by 1840 working class literacy to have reached between 67 and 75 percent.<sup>643</sup> It is likely therefore that any issues of literacy would have been associated with individuals and small groups as opposed to substantial proportions of complete social groups within a given area. William Pitt (1749-1823) of Pendeford was the author of four of the Board of Agriculture's *General View* series in addition to several other agricultural works and his assessment is appropriate:

Respecting the character of Staffordshire farmers, I do not find them at all wanting in industry, or in readiness to adopt established improvements...nor are they at all backward in adopting any system of cultivation, when its advantages become apparent... If farmers have shewn a want of curiosity, and a backwardness of adopting rational projects, it has been owing to their want of information, to their not being in the habits of reading, or acquainting themselves by that means with the practice of other countries, a circumstance owing to a defective education; but this obstacle is now removing, and the farmers will soon be a set of men of equal education with any of equal circumstances.<sup>644</sup>

Limited evidence of acquisition of published agricultural material by Shropshire land owners is present in extant probate inventories but how far such practice extended down the local social scale remains speculation. Equally the issue of engagement with the notions and experiences set forth in such works. In Pitt's testament to local farmers, he argues:

'Notwithstanding the abuse that has formerly been thrown upon them by ignorant writers for backwardness, in following their absurd projects, their time and even their ancient methods of practice were too valuable to be sacrificed to idle theoretical speculations.'<sup>645</sup> But where accessed and consumed, the reports and opinions of agricultural writers would leave an

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<sup>643</sup> Cressy, D. 'Levels of literacy in England, 1530-1730,' and Schofield, R. S., 'Dimensions of illiteracy in England, 1750-1850 in Graff, H. J., *Literacy and social development in the West: a Reader* (Cambridge, 1981); Porter, G. R., *Progress of the Nation* (London, 1851).

<sup>644</sup> Pitt, W., *A general view of the agriculture of the County of Stafford with observation on the means of its improvement* (London, 1794), pp.25-6.

<sup>645</sup> Pitt, W., *A general view of the agriculture of the County of Stafford with observation on the means of its improvement* (London, 1794), pp.25-6.

imprint on the farming reader. Even where propositions were rejected or proved fallacious they heightened the awareness of change.

However, the extent to which change in agricultural practice was transmitted through communal association appears to have been limited prior to the final decade of the eighteenth-century. The facilitation of the exchange of knowledge and experiences and a desire 'to excite the spirit of improvement' was the principal role of agricultural societies, although the social opportunities presented were an added attraction.<sup>646</sup> Periodic shows and the award of premiums for produce, livestock and technical skills, such as ploughing, introduced an element of competition and approbation amongst landowners and farmers and encouraged emulation. The secretary of a farmers' club writing to James Loch, defended the small nature of premiums offered: 'in a poor country where premiums never was before given, and where the spirit of emulation is considerably excited, what we offer, has all the effect that larger sums under different circumstances would have.'<sup>647</sup> In some societies, awards were given to farm servants for faithful service and 'good character' with the aim of fostering a sense of inclusiveness.<sup>648</sup>

A number of national organisations formed in the period from 1750 until the middle of the nineteenth-century, had a declared interest in agricultural development. The Society of Arts (1754) and the Smithfield Club (1798) were among the most prominent but the activities of the Royal Agricultural Society, founded in 1838, and the Farmers' Club, in 1842, fall beyond the chronological scope of this study.<sup>649</sup> The remit of the Society of Arts was the furtherance of improvement in all walks of life and agriculture fell within its ambit. For those awarded a

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<sup>646</sup> Birmingham Archives and Heritage, *Aris's Birmingham Gazette*, 3<sup>rd</sup> March 1800, Advertisement for the formation of the Shifnal Agricultural Society; Staffordshire Record Office, Sutherland Collection, Ref: D593/L/3/11- 'I. Forsyth to J. Loch, 7th June 1813;' Friedel, R., *A culture of improvement: technology and the Western Millennium* (Cambridge, Massachusetts, 2007), p. 176.

<sup>647</sup> Staffordshire Record Office, Sutherland Collection, Ref: D593/L/3/11- 'I. Forsyth to J. Loch, 7th June 1813;'

<sup>648</sup> For example, Staffordshire Record Office, Ref: D1287/10/2/ Q10, *Shropshire General Agricultural Society, Premiums for October, 1811*.

<sup>649</sup> Goddard, N., 'Agricultural literature and societies,' in Mingay, G. E. (ed.), *The Agrarian History of England and Wales, Vol. VI, 1750-1850* (Cambridge, 1989), p. 366.

premium or a fellowship, the society offered the opportunity for constructive networking. But there is no evidence that membership was widely spread amongst Shropshire farmers.

Similarly with the Smithfield Club. It had been established for the improvement and raising of livestock breeds but in the early years notes on its annual shows indicate that the priority of members lay in the pursuit of fattening of animals for market.<sup>650</sup> Membership had been set at half a guinea a year, in order to attract 'practical farmers and graziers, it later being increased to one guinea.'<sup>651</sup> Although the Earl of Bradford appears to have been a member and a number of Shropshire farmers and landlords pursued breed improvement programmes, there is no evidence that there were membership numbers within the county to have rendered the Club a fruitful means of knowledge dissemination.<sup>652</sup> However, that may be a consequence of the surviving record.

The existence of local agricultural societies varied considerably and may be seen to reflect the state of local enthusiasm for improvement. Ian Adams suggests that the pivotal point for the formation of agricultural societies was reached when interest in improvement had been established within its catchment area: that is societies did not stimulate the initial enthusiasm for the process, they were a consequence of that interest.<sup>653</sup> When considered in the context of the avidity within communities rather than of the individual it is a proposition that has merit and may be seen in lowland Scotland in the second half of the eighteenth-century.<sup>654</sup> Boud identified forty-one agricultural societies which were formed in Scotland by 1800 for which the dates of founding were known.<sup>655</sup> By 1835 the total was 133. Additional societies, that were short-lived and for which dates of formation could not be established, also existed. At

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<sup>650</sup> *The Farmer's Magazine, a periodical work exclusively devoted to Agriculture and Rural Affairs*, 8, 1807, pp. 189-192.

<sup>651</sup> *The Farmer's Magazine, a periodical work exclusively devoted to Agriculture and Rural Affairs*, 8, 1807, p. 190.

<sup>652</sup> Staffordshire Record Office, D1287/10/2 (E193-194), *Notice of Agricultural Show to be held from 14th-17th Dec 1810 on behalf of the Smithfield Club*; Wm Childe of Kinlet and Lord Hill of Hawkestone for example were noted breeders.

<sup>653</sup> Adams, I. H., 'The agents of agricultural change,' in Parry, M. L. and Slater, T. R., *The making of the Scottish countryside* (London, 1980, p. 170.

<sup>654</sup> Boud, R. C., 'Scottish Agricultural Improvement Societies, 1723-1835,' *Review of Scottish Culture* (Edinburgh, 1984), pp. 70-90.

<sup>655</sup> Boud, R. C., 'Scottish Agricultural Improvement Societies, 1723-1835,' *Review of Scottish Culture* (Edinburgh, 1984), pp. 76.

least eleven societies had been formed by 1772-3, the date of creation of the first one in England. It suggests a greater degree of enthusiasm and momentum in agricultural improvement in areas of Scotland, a professed agriculturally backward region, than existed south of the border.<sup>656</sup> In contrast with Scotland there were no agricultural societies founded before 1800 in Shropshire; similarly in the case of the adjoining counties of Staffordshire and Cheshire.<sup>657</sup> Herefordshire had a single society founded in the county town in 1797.<sup>658</sup> Any potential benefit arising from communal association were therefore constrained in Shropshire and its immediate economic region in the period up to the end of the century. Following Adams' precept, the absence of agricultural societies prior to 1800 may therefore be indicative of a widespread lack of enthusiasm for agricultural change in Shropshire up to that point.

The first two societies in Shropshire were formed around 1800 at Shifnal and Market Drayton, in the east of the county, a region where progressive changes were adopted earlier than elsewhere.<sup>659</sup> The advertisement for the Shifnal society's first show commends Sir George Pigot and John Cotes Esq. for undertaking the organisation of the society as 'on a View of this County, the Breed(sic) of Stock is much neglected, as well as other Branches of Agriculture.'<sup>660</sup> Sixty-three subscribers registered, from within a radius of six miles of Shifnal, that being the prescribed limit initially set for qualification for membership. It gives evidence of the extent of local eagerness for the society. That being the case it begs the question of why, with the exception of the Market Drayton society and the county society

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<sup>656</sup> Boud, R. C., 'Scottish Agricultural Improvement Societies, 1723-1835,' *Review of Scottish Culture* (Edinburgh, 1984), pp. 73; Smout, T.C., 'A new look at the Scottish Improvers,' in *The Scottish History Review*, Vol. 91: No 231: April 2012, p. 134.

<sup>657</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 351; Pitt, W., *General view of agriculture in the County of Stafford, with observations on the means of its improvement*, (London, 1796), p. 180; Holland, Sir Henry, *general view of the agriculture of Cheshire, with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1808), p. 339.

<sup>658</sup> Duncomb, J., *General view of the agriculture of the county of Hereford, with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1805), p.157.

<sup>659</sup> Bishton, J., 'A general view of the Agriculture of the County of Salop: with observations on the means of its improvement' (Brentford, 1794); Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 40.

<sup>660</sup> Birmingham Archives and Heritage, *Aris's Birmingham Gazette*, 30 March 1800.

formed in 1810, it took so long for other local agricultural societies to emerge. In some instances this may have been due to the existing activities of individual landowners or their agents. Mention has already been made of the apparent influence of Lord Clive and his agents John Ashby and John Probert in the area around Walcot. James Loch created an association of tenants on Lord Stafford's estates for the express purpose of 'promoting the practical improvement of the Country, by encouraging and extending the most improved methods of modern agriculture as suited to diversity of soil, of climate and other circumstances' (Appendix 5/2).<sup>661</sup> Its aims were to encourage the testing of improved implements and the reporting on experiments in cultivation undertaken by any member. Awards would also be made to deserving servants, particularly skilful ploughmen and mechanics. In seeking the Marquis's approval he wrote that, 'no nobleman in England has such a thing and I doubt if with the exception of the Duke of Northumberland anyone has a tenantry capable of forming such a society.'<sup>662</sup>

The existence of the Shropshire General Agricultural Society was of short duration, its dissolution in 1823 being claimed to be by reason of exclusivity of access to its premium competitions.<sup>663</sup> Entry was restricted to subscribers rather than being an open competition, which was a policy followed by other societies and in such circumstances subscriptions generally funded the premiums awarded. The Shifnal society had a similar condition for entry to premium competitions, but advertised for 'any person who is inclined, to become a subscriber.'<sup>664</sup> It is not known whether a tacit restriction or classification on membership was employed by the Shropshire society but the report of the 1819 general meeting makes

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<sup>661</sup> Staffordshire Record Office, Ref: D593/L/3/11, *The Marquis of Stafford's Associated Tenantry for the Improvement of Agriculture*.

<sup>662</sup> Staffordshire Record Office, Ref: D593/K/1/5/2, *Sutherland Collection, Chief agent's out letters, James Loch to The Marquis of Stafford, 11<sup>th</sup> April 1813*.

<sup>663</sup> *Salopian Journal*, 19<sup>th</sup> November 1823 cited in Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844> Date accessed: 1 July 2013.

<sup>664</sup> Birmingham Archives and Heritage, *Aris's Birmingham Gazette*, 30 March 1800. The standard subscription at Shifnal was one guinea.

reference to the election of new members to the society.<sup>665</sup> In the same year, however, premiums were awarded specifically for tenants: for the best and cleanest crop of turnips; the greatest number of acres of watered meadows; and ‘a piece of plate value fifty guineas to the tenant who shall cultivate and improve in the best manner, the Farm he occupies.’ A condition applied to the premium awarded for turnips was a minimum of twenty acres ‘to entitle any Member to show for this premium,’ which indicates that tenants were entitled to membership. The winner, Robert Tench, was also a winner of premiums for livestock in this and the following year and in one category was in competition with Lord Clive.<sup>666</sup> The newspaper report of the show in April 1819 also recorded the presence of ‘many plain practical husbandmen.’<sup>667</sup> Claims of exclusivity are therefore debatable and Sir Charles Rouse Boughton’s reaction on formation of the Shropshire Society was to express pleasure at its institution, noting that, ‘I trust my Shropshire estates and tenants will derive essential benefit from the Agricultural Society.’<sup>668</sup> It indicates no expectation of constraints on the advantages to be gained from its creation.

The further creation of agricultural societies, farmers’ clubs and practical farmers associations in the county took place from the mid-1830s and Ludlow, Oswestry, Wenlock and Bridgnorth, saw the establishment of formal interest groups. The surge of interest is considered by the *Victoria County History* to have origination in the cause of agricultural protectionism rather than affiliation with the ‘spirit of improvement’ but the progressive adoption of the tenets of ‘high farming’ through to the 1860s, cannot be discounted.<sup>669</sup> In overcoming the farmer’s natural obstinacy in his ‘attachment to old practices,’ agricultural

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<sup>665</sup> Shropshire Archives, Ref: 665/3/1303, Cuttings from the Shrewsbury Chronicle re Shropshire Agricultural Society Annual Show .

<sup>666</sup> Shropshire Archives, Ref: 665/3/1303, Cuttings from the Shrewsbury Chronicle re Shropshire Agricultural Society Annual Show .

<sup>667</sup> Shropshire Archives, Ref: 665/3/1303, Cuttings from The Shrewsbury Chronicle re, Shropshire Agricultural Society Annual Show.

<sup>668</sup> Shropshire Archives, Ref:6683/3/27/57, ‘Rouse Boughton family letters, C. W. Rouse Boughton to R. Tench, Bromfield, Ludlow- Dec 3rd 1810.’

<sup>669</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844>

societies had some limited benefit within areas of Shropshire in the early part of the century in that they facilitated association and fostered emulation. In a similar context, John Horsefield, president of Prestwich Botanical Society, Lancashire, wrote of the process of knowledge dissemination through communal association: ‘we instruct one another by continually meeting together; so that the knowledge of one becomes the knowledge of all, and we make up for the deficiency of education by constant application to the subject.’<sup>670</sup>

Emulation was an important factor in the process of agricultural improvement and exemplars were provided by publications, by the association bestowed by agricultural societies and by model and home farms established for the purpose. Marshall argued that the introduction to tenants of ‘valuable practices’ employed on other estates or in other areas should be the prime purpose of a home farm.<sup>671</sup> Within Shropshire examples of model farms were created upon some estates, such as at Dayhouse Farm at Lilleshall, Kinlet and at Walcot Hall.<sup>672</sup> Trials of new crops, techniques and livestock breeding programmes were demonstrated, as was new or improved equipment. There is evidence that farm visits were undertaken by some Shropshire farmers in the early nineteenth-century. The Lilleshall agent, William Lewis, gave one of Lord Stafford’s Shropshire tenants a letter of introduction to James Elliott, the estate agent at Castle Howard in Yorkshire.<sup>673</sup> Lewis also gave a detailed account on his own visits to Ashbridge and Woburn.<sup>674</sup> Emulation could be as beneficial to the estate owners in the improvement of farms, as it was for agents, tenants and owner-farmers. William Childe of Kinlet declared his intention to visit the farm of an acquaintance: ‘I consider it a matter of

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<sup>670</sup> Manchester Guardian 21/12/1850, 5 cited in Secord, A., ‘Science in the pub: artisan botanists in early nineteenth century Lancashire’ in *History of science*, 32:3=97, Sept 1994, p. 280.

<sup>671</sup> Marshall, W. *On the Landed Property of England, an elementary and practical treatise; containing the purchase, the improvement and the management of Landed Estates* (London, 1804), p. 417.

<sup>672</sup> Staffordshire Record Office, Sutherland Collection, Ref: D593/K/1/5/2, Chief agent’s out letters, ‘Loch to Earl Gower, 4th April 1813 and Loch to Lord Stafford, 11<sup>th</sup> April 1813; Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 124.

<sup>673</sup> Staffordshire Record Office, Sutherland Collection, Ref: D593/K/3/5/1-5, Private correspondence of Wm Lewis, 1816-22, ‘Lewis to James Elliott, Castle Howard, 20<sup>th</sup> January 1819.’

<sup>674</sup> Staffordshire Record Office, Sutherland Collection, Ref: D593/K/3/5/1-5, Private correspondence of Wm Lewis, 1816-22, ‘Lewis to Loch, 21<sup>st</sup> May 1821.’

considerable importance to satisfy myself whether his system of agriculture is really a desirable one, and particularly whether it be adapted to a cold, tenacious and even clay soil as it be my lot to cultivate.’<sup>675</sup> In his evidence to the Parliamentary Select Committee in 1833, Richard White was of the opinion that improvement in the agriculture of Shropshire had been achieved because its previous backward state left scope for improvement; added to which were the introduction of a better system of husbandry ‘and great emulation among the farmers.’<sup>676</sup> Emulation in respect of farming practice is therefore identifiable in the county from the end of the eighteenth-century but is less apparent earlier. That may have arisen as a consequence of the widespread lack of understanding of the opportunities that existed. The heightening of awareness that the organs of knowledge dissemination initiated, helped break down the barriers to improvement.

#### **5.4 Agricultural Improvement in Shropshire (1750-1840)**

At the beginning of this chapter attention was drawn to the constraining influences upon much of Shropshire agriculture, of the topography and local climate. The variability of soil types determined the form of husbandry employed and what Kent described as an obstinate attachment to old practices, furthered resistance to change. It took the emergence of new methods and a ‘spirit of improvement’ amongst farmers and landowners to address those impediments. White’s reference to the backward state of cultivation in the first decade of the century was a subjective opinion of the conditions as they stood and he clearly had no contextual references to what had gone before. His statement accords with the condemnatory comments of John Bishton: ‘A large majority of the farmers in this county...are bad

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<sup>675</sup> Staffordshire Record Office, Bridgeman/ Bradford Collection, Ref: D1287/10/2/(Q10), ‘Letters to Orlando, Lord Bradford re formation of Shropshire Agricultural Society 1810-1811, W. Childe to Bradford, 24<sup>th</sup> October 1810.’

<sup>676</sup> ‘Report from the Select Committee on Agriculture,’ 1833., Evidence of Richard White, 14<sup>th</sup> May 1833, Question 473, House of Commons Parliamentary Papers, <http://parlipapers.chadwyck.co.uk>

cultivators in the common method of husbandry.<sup>677</sup> White had farmed in Durham prior to coming to Shropshire and was, therefore, unlikely to be aware of prior progress in improvement across the county or on a more parochial level.<sup>678</sup> In White's opinion, however, Herefordshire was equally backward.

By 1806/7, when White arrived in Shropshire, John Bishton and his son, John, as estate agents for the Gower/ Stafford estates, had initiated change in the form of tenure on the estates, from one based upon the duration of nominated lives to 'tenancy at will.'<sup>679</sup> It provided the landlord with the expectation of increasing future rental revenues and the tenants with the landlord's commitment to capital investment that the farms desperately needed. Under the Clive family the adoption of progressive husbandry in the south of the county was well-established and on the light, fertile soils of the north-east the 'spirit of improvement' was being fostered by the agricultural societies at Shifnal and Market Drayton. Plymley acknowledged that the variety of farms and practices in the county were, 'probably as various as man...maybe in the same proportion as in other counties, under the same degree of improvement,' and he notes that, 'in all parts of this county, examples of superior husbandry may be met with.'<sup>680</sup>

#### **5.4.1 Enclosure and drainage**

The enclosure of land and its draining was sometimes a precursor to initiation of improvement activity and in parts of Britain it represented a major factor in agricultural reform.<sup>681</sup> In Shropshire, however, open-field enclosure had taken place well before the onset of

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<sup>677</sup> Bishton, J., *A general view of the Agriculture of the County of Salop: with observations on the means of its improvement* (Brentford, 1794), p. 11.

<sup>678</sup> 'Report from the Select Committee on Agriculture,' 1833., Evidence of Richard White, 14th May 1833, Questions 358-361, House of Commons Parliamentary Papers, <http://parlipapers.chadwyck.co.uk>

<sup>679</sup> Wordie, J. R., 1982, *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982), p. 183.

<sup>680</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 123.

<sup>681</sup> Thirsk, J. (ed.), *The agrarian history of England and Wales, Vol 5 1640-1750, regional farming systems*, p. 47-8.

eighteenth-century parliamentary enclosure and such as was enacted, largely involved waste and common land.<sup>682</sup> In the period from 1765 to 1854 fifty-one awards totalling 51,755 acres were enacted, including approximately 2,500 acres of open-field land.<sup>683</sup> In addition there were private agreements registered with clerks of the peace amounting to 4,874 acres. Approximately 6 per cent of the county was therefore enclosed in a ninety year period. Consequently, Turner considers that the extent of enclosure in Shropshire and the border counties of Wales was ‘insignificant’ in terms of agricultural improvement.<sup>684</sup> The proclaimed reasons for acts of enclosure were many and varied and the non-productive nature of commons and wastes made them obvious targets for those who sought the opportunity to bring more land into productive use. There were not uncommonly different grounds for enclosure among supporters of the same petition and any one supporter may have multiple reasons.<sup>685</sup> Nationally more than 70 percent of enclosure acts between 1757 and 1835 have been estimated to have included provision for the commutation of tithes.<sup>686</sup> Some claims for enactment centred upon the eradication of encroachment. Plymley refers to large common wastes such as Clun forest where neighbouring farms were left uncultivated due to the ramifications of encroachment from the commons.<sup>687</sup> Francis Marston, a land agent from Hopesay, near Ludlow, confirmed that the sheep left to graze common land destroyed crops, even where fenced and undermined the prospects of improvement in the surrounding areas.<sup>688</sup> An inability to raise improved breeds of livestock because of the consequential lack

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<sup>682</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231;

<http://www.british-history.ac.uk/report.aspx?compid=22844>

<sup>683</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231;

<http://www.british-history.ac.uk/report.aspx?compid=22844>

<sup>684</sup> Turner, M., *English Parliamentary enclosure: its historical geography and economic history* (Folkestone, 1980), p. 54.

<sup>685</sup> Brown, D. G., *Enclosure and Improvement: an investigation into the motives for Parliamentary enclosure*, Unpublished PhD thesis, Wolverhampton Polytechnic, 1992, p. 15.

<sup>686</sup> Brown, D. G., *Enclosure and Improvement: an investigation into the motives for Parliamentary enclosure*, Unpublished PhD thesis, Wolverhampton Polytechnic, 1992, p. 39.

<sup>687</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 144.

<sup>688</sup> ‘Report from the Select Committee on commons’ inclosure,’ 1844, House of Commons Parliamentary Papers, Evidence of Francis Marston, Question 2365, <http://parlipapers.chadwyck.co.uk>

of fodder crops, arose from encroachment.<sup>689</sup> He declared that improvement in farming had been achieved in all the parishes in his own locality as a consequence of enclosure; introduction of improved breeds had contributed to profits of sheep farming, which had increased from £30 to £100 per annum; and the level of tithes in the township had doubled on account of increased property values.<sup>690</sup>

Frequently applications for a local act were justified on the grounds of improvement but the improvement envisaged was not always agricultural. Emparkment of estates or establishment of plantations enhanced aesthetic values and rather than addressing immediate issues of income, displayed forethought for future generations. William Childe planted some fifty acres of oaks around 1800 and the first Lord Berwick was a substantial ‘planter.’<sup>691</sup> Given the time taken for trees to mature it may have represented the physical manifestation of Enlightenment ideals: alternatively the sense of obligation that one generation feels to the next. The commercial development of estates was sometimes financed from the consequences of enclosure as witnessed in part by the Earl of Bradford’s development of Walsall.<sup>692</sup> Social obligation was also addressed. Richard Reynolds assigned part of his manorial wastes and woodland to public recreation at Coalbrookdale; in Newport, Shropshire in 1764 income from leases of enclosed commons were utilised to maintain public buildings and pay the poor to undertake civic work.<sup>693</sup> But with regards to agriculture, the issue of enhancement of income is always present when considering justification for enclosure. Brown contends that the actions of individuals should be assessed rather than any general attribution of the pursuit of profit. However, twenty-six of the fifty-one parliamentary acts for enclosure in Shropshire

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<sup>689</sup> ‘Report from the Select Committee on commons’ inclosure,’ 1844, House of Commons Parliamentary Papers, Evidence of Francis Marston, Question 2365, <http://parlipapers.chadwyck.co.uk>

<sup>690</sup> ‘Report from the Select Committee on commons’ inclosure,’ 1844, House of Commons Parliamentary Papers, Evidence of Francis Marston, Questions 2389-90, <http://parlipapers.chadwyck.co.uk>

<sup>691</sup> Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 87; Coulton, B., *A Shropshire squire: Noel Hill, first Lord Berwick, 1745-1789* (Shrewsbury, 1989), p. 32.

<sup>692</sup> Staffordshire Record Office, Bridgeman Bradford collection, Ref: D1287.

<sup>693</sup> Trinder, B., *Industrial Revolution in Shropshire*. (London, 2000) p. 220; Brown, D. G., *Enclosure and Improvement: an investigation into the motives for Parliamentary enclosure*, Unpublished PhD thesis, Wolverhampton Polytechnic, 1992, p. 184 & 188.

arose at a time of war, between 1793 and 1815, when the threat of the loss of imported grain existed.<sup>694</sup> The market price of cereals rose dramatically in this period both from the effects of war and successive years of poor harvests and much pasture was converted to arable in order to take advantage of increased prices or the potential need to feed the nation.<sup>695</sup>

Inevitably enclosed wastes required substantial reclamation to bring the land up to productive quality. Draining of the extensive moorland that was enclosed in most parts of Shropshire, was largely effected by open ditches that also served as field and farm boundaries but ‘underdraining’ began to be adopted from the 1770s.<sup>696</sup> The agricultural writers advocated the benefits of draining land from the middle of the eighteenth-century, Johnstone making the point that, ‘if land be in tillage, and remain wet, every manure that can be applied to it loses its effect...if in pasture, the grass it produces is a coarse unhealthy nature.’<sup>697</sup> In terms of overall improvement it led to increased yields, wider crop options and greater flexibility in land use.<sup>698</sup> Kent, Young and Bishton all promoted its efficacy but as with the application of improvements in husbandry, its adoption by Shropshire farmers was variable.<sup>699</sup> Bishton reported that a great deal was being done by ‘the best farmers’ to improve drainage.<sup>700</sup>

However Robert Tench, who farmed at Bromfield in the south of the county, commented that, ‘there are but few of the farmers in this neighbourhood who have till lately, paid much attention to draining their lands, a considerable quantity of which would be much improved

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<sup>694</sup> Turner, M., *English Parliamentary Enclosure: its Historical Geography and Economic History* (Folkestone, 1980), p. 77; Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 22.

<sup>695</sup> Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 22.

<sup>696</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 222; Mingay, G. E. (ed.), *The Agrarian History of England and Wales, Vol. VI, 1750-1850* (Cambridge, 1989), p. 284.

<sup>697</sup> Maxwell, R., *The Practical Husbandman: being a collection of miscellaneous papers on husbandry etc* (Edinburgh, 1757), p. 7;

Johnstone, J., *An account of the most improved mode of draining land* (Dublin, 1800), p. 3.

<sup>698</sup> Phillips, A. D. M., *The underdraining of farmland in England in the nineteenth-century*, (Cambridge, 1989), p. 2.

<sup>699</sup> Kent, N., *Hints to gentlemen of landed property* London, 1775, pp. 17-19; Young, A., ‘Journal of a Tour, *Annals of Agriculture*, Vol. 4 (London, 1775), p. 138; Bishton, J., *A general view of the Agriculture of the County of Salop: with observations on the means of its improvement* (Brentford, 1794), p. 17-18.

<sup>700</sup> Bishton, J., *A general view of the Agriculture of the County of Salop: with observations on the means of its improvement* (Brentford, 1794), p. 7.

by so doing.’<sup>701</sup> James Loch, in the reorganisation of the Gower/Stafford estates, placed great sway upon the importance of effective draining.<sup>702</sup> He recorded the laying of 34,000 yards of drains at Cheswell Grange Farm and 14,000 yards at Lilleshall Hall Farm. From 1817-1821 William Childe invested heavily in drainage on his estates, as did Robert Clive from the 1820s, but there were clearly areas of Shropshire which were still inadequately drained towards the middle of the nineteenth-century.<sup>703</sup> It was an expensive process and a shortage of free capital prevented some from investing.<sup>704</sup> The limitations of clay tiles and other forms of underdraining, particularly on heavy clay soils, may have dissuaded others. It was in the 1840s that the emergence of cylindrical clay pipes and the machinery to manufacture them afforded the opportunity to effectively address the drainage of heavy clay lands and R. H. Clive was prominent in their promotion.<sup>705</sup>

#### 5.4.2 New methods of husbandry

The adoption of new methods of husbandry in Shropshire was undeniably slow and irregular. However as Dodd points out, Bishton’s application of the Norfolk system of crop rotation as a benchmark against which to measure the state of agriculture, was misleading.<sup>706</sup> The absence of four-course rotation was neither a sign of stubbornness nor ignorance: much of the land within the county was not suited to the application of that particular methodology. In other cases there may have been insufficient recourse to manure to adequately enhance the fertility

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<sup>701</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 228.

<sup>702</sup> Loch, J., *Account of the improvements on the estates of the Marquis of Stafford in Shropshire, Staffordshire and Sutherland* (London, 1820), p. 179; Staffordshire Record Office, Sutherland collection, Ref: Ref D593/K/1/5/4, Chief agent’s out letters- 1815, ‘Loch to Lord Hardwicke, 28<sup>th</sup> March 1815.’

<sup>703</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844>; Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 197.

<sup>704</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844>

<sup>705</sup> Protheroe, R., Ernle, Lord, *English farming past and present*, 4<sup>th</sup> ed, (London, 1927); Phillips, A. D. M., *The underdraining of farmland in England in the nineteenth-century*, Cambridge, 1989, p. 14; Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844>

<sup>706</sup> Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 31; Bishton, J., *A general view of the Agriculture of the County of Salop: with observations on the means of its improvement* (Brentford, 1794), p.11.

of the soil to enable its utilisation.<sup>707</sup> A major constraint was the state of roads which Plymley marked as being ‘almost impassable’ in parts of the county.<sup>708</sup> Despite this Plymley was able to draw attention to the ‘examples of superior husbandry’ that prevailed and ‘alternative crops’ that were being grown.<sup>709</sup> Turnips were considered an ‘improving crop’ and featured in the standard Norfolk rotation but were not necessarily employed in that context by all contemporary Shropshire farmers who grew them. Evidence exists of their being grown as a fodder crop on the Clive estates from the 1770s; they were recorded near Bridgnorth in 1795; and Edward Harries, owner of the Benthall estate, declared that few farmers in the county with suitable soil would be without a field of them.<sup>710</sup> Harries also commented on peas being ‘more grown on our sound soil than any other county.’ As alternative crops, cabbage had been grown from the 1770s for stall-feeding of cattle; the 1801 Crop Returns reported turnips and rapeseed in many areas of Shropshire, and potatoes were grown widely, although with the exception of the vicinity of Shrewsbury, the acreage was small.<sup>711</sup> The increasing application of manure and lime to the land had taken place although the state of the roads was, in many places, a limiting factor well into the nineteenth-century.<sup>712</sup> Loch records the resolution of the problem on Lilleshall Hall Farm: ‘This defect is now remedied by means of excellent roads

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<sup>707</sup> Minge, G. E. (ed.), *The Agrarian History of England and Wales, Vol. VI, 1750-1850* (Cambridge, 1989), p. 281.

<sup>708</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 273; see also Protheroe, R., Ermlé, Lord, *English farming past and present*, 4<sup>th</sup> ed, (London, 1927), p. 203 for a national perspective.

<sup>709</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 123.

<sup>710</sup> Nichol, J. D., ‘Social life and political stability in 18th century provincial life. A study of the career of John Ashby (1722-1779) of Shrewsbury,’ *Transactions of the Shropshire Archaeological and history Society*, 59 (1969-70), p. 60; Rowley, R., *Annals of Agriculture*, 24, 1795, p. 270; Harries, E., in Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 174.

<sup>711</sup> ‘Home Office Acreage returns Pt II, pp178-195 in Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844>.

<sup>712</sup> Hey, David, ‘The North-West Midlands: Derbyshire, Staffordshire, Cheshire, and Shropshire,’ in Thirsk, J. (ed.), *The Agrarian History of England and Wales, Vol. 5.1 '1640-1750: Regional Farming Systems'* (Cambridge, 1984), p. 151; Rowley, R., in Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 234.

being made through it, enabling the tenant to drive muck and lime at all seasons, which he has done to a great extent.’<sup>713</sup>

By 1833 Richard White was extolling the improvement that had been effected within Shropshire agriculture from the beginning of the century through the adoption of a new system of farming and the heightening of the spirit of emulation amongst farmers.<sup>714</sup> The implementation of new policies and organisation by some landowners and agents were clearly influential in the process of change. Despite the *Victoria County History* declaring the existence of Norfolk rotations in the 1820s in the west and south of the county, Dodd’s thesis, upon which the claim is founded, is less explicit.<sup>715</sup> He identifies locations of turnip cultivation but notes the absence of specific references to their part in rotations and quotes a report from the Clive estates’ agent. Referring to turnips grown on a number of estate farms he considers that: ‘the system is irregular and must be altered and put in the four course.’<sup>716</sup>

Although most of post-war Shropshire agriculture remained a mixed-farming culture, in predominantly pastoral areas a number of the owners established and improved livestock breeds. Childe of Kinlet had a herd of Devon cattle, at Rowton Castle the Lysters specialized in Alderneys; Lord Berwick developed a herd of Herefords of some renown and his relative Lord Hill had Shorthorns at Hawkestone.<sup>717</sup> Improvements in sheep largely centred on the introduction of Leicester and Southdown breeds to improve native stocks. The 6<sup>th</sup> Duke of Bedford wrote to Lord Bradford, ‘I am most happy to find you approve of the ram I sent to Weston... I hope he will give good service to your flock.’ From the selective breeding

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<sup>713</sup> Loch, J., *Account of the improvements on the estates of the Marquis of Stafford in Shropshire, Staffordshire and Sutherland* (London, 1820), p. 236.

<sup>714</sup> ‘Report from the Select Committee on Agriculture,’ 1833., Evidence of Richard White, 14th May 1833, Question 473, House of Commons Parliamentary Papers, <http://parlipapers.chadwyck.co.uk>

<sup>715</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844>.; Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 31.

<sup>716</sup> Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 34-5 citing SA, Ref: 4119, Rentals of Oakly Park Estate, 1807-67.

<sup>717</sup> Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 146-7.

programmes the Shropshire Down emerged in the 1830s and later in the nineteenth century became the first breed of sheep in the country to have a published flock book.<sup>718</sup>

As with the adoption of modern cultivation practices the acceptance of improved implements and machinery in Shropshire was protracted. In the most visible cases they were promoted by landowners and agents such as Childe, Clive and Loch. Childe's passion for agriculture no doubt drove his acquisitive instincts to purchase and develop an extensive range of equipment, with the local blacksmith being charged to manufacture 'the more uncommon sorts.'<sup>719</sup> In places within the county mechanical threshing and winnowing machines were present by the end of the eighteenth-century, although in 1794 William Pitt declared that they had long been in use in Staffordshire, which suggests that may also have been the case in Shropshire.<sup>720</sup> Early machines were generally attached to buildings as indicated by Loch, but over time they became mobile and eventually steam-powered.<sup>721</sup> The ironmaster, John Wilkinson, was reported to have installed a steam-powered threshing machine at his Brymbo Farm which he bought in 1793, and was reputedly one of the first in the country.<sup>722</sup> Seed-drills, for the laying of seed within furrows rather than the traditional method of dispersal by hand or broadcasting, had been invented towards the end of the seventeenth-century. Based upon newspaper advertisements, the *Victoria County History* determines that they were not widely employed in Shropshire before the 1820s.<sup>723</sup> Pitt's view of the position in neighbouring Staffordshire is again somewhat different, claiming that drill-husbandry was

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<sup>718</sup> Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 147; Shimwell, S., 'The Shropshire Sheep Breeders' Association and Flock Book Society', [www.shropshire-sheep.co.uk](http://www.shropshire-sheep.co.uk).

<sup>719</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 142.

<sup>720</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 141; Pitt, W., *A general view of the agriculture of Staffordshire*, (London, 1794); p. 87.

<sup>721</sup> Loch, J., An account of the improvements on the estates of the Marquis of Stafford in the counties of Stafford, Shropshire and the estate of Sutherland (London, 1820), p. 181; Mingay, G. E. (ed.), *The Agrarian History of England and Wales, Vol. VI, 1750-1850* (Cambridge, 1989), p. 526; Shropshire Archives, Ref: MI 4329- 1811, 'Diary of J. U. Rastrick, 7<sup>th</sup> April 1811.'

<sup>722</sup> Dickinson, H. W., *John Wilkinson, ironmaster, 1728-1808* (Ulveston, 1914), p. 36.

<sup>723</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844>

establishing itself by the turn of the century and quoting referees for the benefits imparted.<sup>724</sup>

That similar dispersal in Shropshire had not evolved, particularly in the lighter-soil areas, seems surprising but cannot at present be challenged on the basis of substantive evidence.

Blacksmiths were widely employed in manufacturing agricultural implements, particularly ploughs which were often produced to meet local and personal preferences. Equipment manufacturers and their agents were establishing themselves by the end of the eighteenth-century. Joseph Cornforth at Bushbury near Wolverhampton, was supplying threshing machines in the 1790s.<sup>725</sup> The ironmaster John Onions of Broseley patented his own version in 1810 as did Hazeldine and Rastrick of Bridgnorth, who were advertising theirs by 1812.<sup>726</sup> John Rastrick wrote in his diary, '7 April 1811 Sunday-All day at home writing and drawing of portable thrashing machine.'<sup>727</sup> Hazeldine had also patented a design for a plough specifically for the clay soil found in parts of the county.<sup>728</sup> Local agents were established in Shropshire for manufacturers such as Ransomes of Ipswich and Richmond and Chandler of Manchester and by the middle of the century agricultural machinery sales were becoming more prominent in local newspapers.<sup>729</sup>

Caution on the part of some farmers in venturing away from what was familiar, applied as much to machinery and implements as it did to methods of husbandry. In order to overcome resistance amongst Stafford tenants the agent James Loch established tenants' days at the home farm to demonstrate the use of improved technology. He also negotiated with an equipment manufacturer, Samuel Morton of Edinburgh, for the location of manufactories

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<sup>724</sup> Pitt, W., *A general view of the agriculture of Staffordshire*, (London, 1794); p. 87.

<sup>725</sup> Pitt, W., *A general view of the agriculture of Staffordshire*, (London, 1794); p. 87.

<sup>726</sup> Shropshire Archives, Ref C20, 'Richard Prosser (Superintendent of Examiners at the Patent Office), 'A list of patents granted under the old law 1617-1852 to persons resident in Shropshire;' *The Gentleman's Magazine*, 80, 1810, p. 659; *Shrewsbury Chronicle*, 28<sup>th</sup> February 1812.

<sup>727</sup> Shropshire Archives, Ref: MI 4329-1811, Diary of J. U. Rastrick, 7<sup>th</sup> April 1811.

<sup>728</sup> Shropshire Archives, Ref C20, 'Richard Prosser (Superintendent of Examiners at the Patent Office), 'A list of patents granted under the old law 1617-1852 to persons resident in Shropshire;' *The Gentleman's Magazine*, 80, 1810, p. 659-60.

<sup>729</sup> Baugh, G. C. And Elrington, C. R. (eds.) *A History of the County of Shropshire: Volume 4: Agriculture* (1989), pp. 168-231; <http://www.british-history.ac.uk/report.aspx?compid=22844>

close to the major Stafford estates at Lilleshall and Trentham to check those who made recourse to lack of availability, for non-compliance with the landlord's prescriptions. Like several of the agents identified in this chapter, Loch's approach to estate agency was progressive and it is appropriate to consider the early period of his tenure in more detail.

Image: 5/2



Samuel Morton's Revolving Brake Harrow with permission of the National Library of Scotland

## 5.5 Case Study-James Loch and Agricultural Improvement

The appointment of James Loch (1780-1855) as chief agent for his estates in 1812 was an inspired choice by Lord Stafford, although he had the opportunity to gauge the merit of the man over the previous two years when he was acting in the role of an advisor. With formative years spent on his uncle's estate at Blair Adam, Loch experienced at first hand the issues of management of landed property at a time when a 'spirit of improvement' was still identifiable in Scotland. At Edinburgh University he studied law but found interest in a wide-range of subjects and was tutored in political economy by the philosopher, Dugald Stewart (1753-1828).<sup>730</sup> Stewart's lectures developed references from Adam Smith and Thomas Malthus but incorporated the notion of 'moral citizenship'.<sup>731</sup> He also addressed the moral conflicts between the creation of wealth and promotion of the common good, espoused the education of the lower ranks and society's advancement through the diffusion of knowledge. Loch and his companions therefore had direct exposure to expressions of Enlightenment philosophy that found practical articulation in later life. Amongst those contemporary associates were Henry Brougham, Lord Henry Petty, later Marquis of Lansdowne, Francis Horner, John Murray and Sydney Smith, and whilst at Edinburgh, Loch became president and a prominent debater in the Speculative Society at the University.<sup>732</sup> He qualified as a lawyer in 1801 and was called to the English bar in 1806. Whilst establishing himself as a lawyer in London he was gaining a reputation as a political activist and organiser. In keeping with the cultural ethos of the time he was an active networker and was undoubtedly aided by his uncle, William Adam's role as a whig political manager and former MP.<sup>733</sup> Adam was also appointed in 1802 as auditor to

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<sup>730</sup> Richards. E., *The Leviathan of Wealth* (London, 1973), pp. 19-21 .

<sup>731</sup> Brown, M. P., 'Stewart, Dugald (1753-1828)', *Oxford dictionary of national biography* (Oxford, 2004).

<sup>732</sup> Richards. E., *The Leviathan of Wealth* (London, 1973), pp. 19-21

<sup>733</sup> Richards. E., *The Leviathan of Wealth* (London, 1973), pp. 19-21; Richards, E., 'Loch, James (1780-1855)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004, <http://www.oxforddnb.com/view/article/16883>, accessed 15 June 2011; Wordie, J. R., *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982), p. 64.

the 6<sup>th</sup> Duke of Bedford, who was related by marriage to the Staffords and Richards claims that Adams was instrumental in securing for his nephew the post of estate agent to Lord Stafford.<sup>734</sup>

### 5.5.1 Character and ethos

Loch was intelligent, organised, determined and with progressive political convictions that complemented the Marquis's own. Whilst Wordie's view of him as being equally 'arrogant, impatient and unsympathetic', undoubtedly support the published public persona, examples from his estate correspondence during the period to the mid-eighteen-twenties do not endorse that judgement.<sup>735</sup> Loch frequently attested to the obligations incumbent in the role he occupied and he reminded his sub-agents that they, 'must be the principal gentlemen of the district, capable of acting as a deputy Lt and JP, and be very kind and forbearing to a most worthy excellent set of poor tenants, who require to be much encouraged in their most praiseworthy exertions of improvement.'<sup>736</sup> His duty to the interests of the Marquis of Stafford and his family were at the forefront of his considerations and in the resolution of conflicts in his perceived responsibilities he sought to determine them in the manner expected of him: in full possession and after consideration of the facts of the case; with no adverse implications to the interests of the Stafford family; and with recognition of the implications to any others involved.<sup>737</sup> But as shown above he was not averse to apprising others of the obligations that they themselves bore. The direction of improvements to the husbandry and management of the estate having been determined by the landowner and Loch, the tenants were expected to comply with the terms of their occupancy, and failure to do so attracted

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<sup>734</sup> Richards, E., 1973, *The Leviathan of Wealth* (London, 1973), p. 24.

<sup>735</sup> Wordie, J. R., *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982), p.74.

<sup>736</sup> National Library of Scotland, MS 926, Loch to Lockhart, 24 March 1827, cited in Eric Richards, 'Loch, James (1780–1855)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004, <http://www.oxforddnb.com/view/article/16883>, accessed 15 June 2011.

<sup>737</sup> '...these reasons being personal to myself alone therefore are to be disregarded by me in executing my duty towards his Lordship...', Loch to Mr Fox (tenant), 20 November 1815, Staffordshire Record Office, Ref: Sutherland Collection, Chief agent's out letters- 1815, D593/K/1/5/4

admonition: 'I must again remind you that in the understanding expressed by me for the management of the Donnington Farm, ploughing with two horses was requisite and the use of broad wheels to your waggons (sic). I hope you will not lose sight of these two things the introduction of which is a very great object with me.'<sup>738</sup>

In this and other correspondence of a similar nature the tone is not overtly aggressive. He offers encouragement and the opportunity to visit other farms or estates employing the husbandry he himself is advocating.<sup>739</sup> He makes suggestions of reading matter that set out the point that he is promoting, determining that it should be passed on to neighbouring fellow-tenants, whereby he will come and discuss the issues with them.<sup>740</sup> But he was clearly not reticent in enforcing his considered view when circumstances dictate. Examples of prevarication or obfuscation set to delay implementation of improvement were addressed. Tenants who did not or were not able to adopt proposed improved practices stood the risk, under the new tenancy regime, of losing their farm on the grounds of not fulfilling their tenancy obligations. As were those who were persistently or substantially in arrears with their rents:

...If I saw any prospect of your getting into a better situation I should not hesitate to recommend the postponement of the payment of your rent so as to enable you to meet the times to get forward with the cultivation of the farm and thus ultimately to repay yourself & pay Lord Stafford. But you must be aware that the outlay of a large sum is required to bring this farm into a productive state, which you cannot command. That the money which has as yet been expended upon it, has been laid out by his Lordship and that therefore any accommodation such as I allude to would only be running you

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<sup>738</sup> Staffordshire Record Office, Ref: Sutherland Collection, Chief agent's out letters- 1815, D593/K/1/5/4, Loch to Mr Boycott (tenant of Donnington Farm) 11th Nov 1815.

<sup>739</sup> Wordie, J. R., *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982), p.206; Staffordshire Record Office, Ref: Sutherland Collection, Chief agent's out letters- 1815, D593/K/1/5/4; Trentham OUT letters- Wm Lewis, Lewis to Loch- 15<sup>th</sup> Oct 1821; Ref: D593/K/3/2/3, Loch to Mr Adams(tenant) 2<sup>nd</sup> Feb 1815.

<sup>740</sup> Staffordshire Record Office, Ref: Sutherland Collection, Chief agent's Out Letters- 1815, D593/K/1/5/4, Loch to Mr Adams (tenant) 2nd Feb 1815,.

deeper in debt without the least chance of improvement. I must also repeat that your habits do not lead you to the exertions such a farm requires.<sup>741</sup>

Those who failed in their appointed positions were replaced and in the newly created positions of under-agent to himself, Loch employed men of great skill and with a work ethic to match his own. Large capital investments were undertaken by the landlord as compensation to tenants for the adoption of 'tenancies at will' and increases in rents, and agricultural practices were imposed that offered the promise of better results for landlord and tenant. Restructuring of estates were initiated, in a very substantial way in Sutherland, but also at Lilleshall and Trentham. Farm layouts were re-organised or consolidated, new roads were laid or existing ones improved, new farm buildings were built and major drainage schemes were undertaken. Where tenants were removed from their holdings due to re-organisation, compensation was paid or alternative properties were offered. But whilst Loch and Lord Stafford recognised that substantial investment in capital infrastructure and the adoption of modern farming and husbandry practices were essential for the improvement of the estates, it was a process to be advanced more successfully by the willing participation of the tenants. The establishment of the model farm at Dayhouse and the tenant's agricultural society represented, in part, an endeavour to create communal spirit amongst tenants of the estates. Loch's suggestion to Earl Gower that great benefits would arise from the attendance of the Earl and members of the Stafford family at the first estate show at Dayhouse, was calculated to further that goal.<sup>742</sup> The presence of the heir was a visible symbol of the relationship that existed between landlord and tenants and conveyed an expression of interest in the welfare of the tenants on the part of the family. The intention was to provide an opportunity for some ninety 'principal tenants' to meet their neighbours and fellow tenants and establish, what

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<sup>741</sup> Staffordshire Record Office, Ref: Sutherland Collection, Chief agent's out letters- 1815, D593/K/1/5/4, Loch to Mr Fox (tenant), 20th November 1815.

<sup>742</sup> Staffordshire Record Office, Ref: Sutherland Collection, Chief agent's out letters, D593/K/1/5/2, Loch to Earl Gower 4th April 1813.

Loch describes as ‘esprit-du-corps’ amongst them.<sup>743</sup> The perceived advantages for the estate to be secured from the successful establishment of such association can be summarised as: the undermining of resistance on the part of uninformed or recalcitrant tenants against adoption of improved practices; economic benefits to both tenants and landlord and a contented tenantry. In addition to being a home farm, Dayhouse was intended to be used to trial new crops or variations and alternative livestock breeds. Ploughing matches were held and new equipment was demonstrated and farmers and agents were encouraged to visit this and other farms on the estates and wider afield in order to foster emulation.<sup>744</sup> In a similar vein, the creation of a tenant’s association on the estates was established to draw the tenantry together, with the ultimate aim ‘of bringing the greatest possible produce to market at the least possible expence’ (sic) (see Appendix 5/2).<sup>745</sup> Mutual encouragement and the reporting of practical experiences were to be employed in the promotion of improvement.

### **5.5.2 Estate improvements**

The extent to which the changes and innovations that he enacted on the Stafford estates were original is largely irrelevant. As referred to in the introduction, in the context of these estates and the specific areas of Shropshire and South Staffordshire in which they were employed, they were designed to advance the condition of agriculture and the income generative value of the property. His enactment of those improvements was occasionally highly innovative in itself. In the process of persuading tenants to switch to new techniques and equipment he not only employed the art of persuasion and demonstration, as occasioned by the Dayhouse show, but arranged for a manufacturer of agricultural implements to set up operations near Lilleshall

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<sup>743</sup> Staffordshire Record Office, Sutherland Collection, chief agent’s OUT letters 1813, Ref: D593/K/1/5/2, Loch to Earl Gower 4th April 1813.

<sup>744</sup> Staffordshire Record Office, Ref: Sutherland Collection, Chief agent’s out letters- 1815, D593/K/1/5/4, Loch to Lord Hardwicke 28th March 1815; Staffordshire Record Office, Ref: Sutherland Collection, Private correspondence of Wm Lewis 1816-1822, D593/K/3/5/1-5, Wm Lewis to James Elliott- Castle Howard-20th January 1819.

<sup>745</sup> Staffordshire Record Office, Ref: Sutherland Collection, D593/L/3/11, ‘The Marquis of Stafford’s Associated Tenantry for the Improvement of Agriculture.’ See Appendix 5/2.

and Trentham estates.<sup>746</sup> Among the techniques he sought to introduce was the utilisation of horses harnessed two-abreast in ploughing, rather than the traditional four or five animals in line-astern. It was a process that was more effective and cost-efficient and was already in use in other parts of the country. 'By diligence and patient explanation the superiority of the Scotch mode of ploughing on stiff land is now acknowledged by all the tenants and some of their servants and by an order of 91 ploughs I calculate on an annual saving of better than £7,700.'<sup>747</sup> He was also insistent on the use of seed drills and hoes for certain crops and wanted ploughed furrows to be in straight lines to aid land drainage.<sup>748</sup>

The issue of inappropriate husbandry within the region was addressed by a number of contemporary commentators as exemplified by previous references to Young, Plymley and Bishton and insistence on change to modern systems on the Stafford estates became a cause with Loch. He wrote to advise tenant William Ford instructing him on the crop rotations he must follow:

There must be no two White Corn crops arising on your turnips land-1. Clover 2. Wheat 3. Turnips 4. Oats or Barley is a good rotation-

On your heavy land if you do not continue in your present method- 1. Fallow 2. Wheat 3. Turnips or clover 4. Barley or Oats 5. Beans or turnips 6. Oats, Barley or early Wheat appears a very advisable method of cropping your land but if you continue your present method 1. Fallow 2. Wheat 3. Clover 4. Oats or Barley must be adopted.<sup>749</sup>

He displays recognition of the need for alternative systems of cropping, dependent upon prevailing soil conditions and he introduced Cropping Books to the estates, whereby the crops

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<sup>746</sup> Loch, J. *Account of the improvements on the estates of the Marquis of Stafford in Shropshire, Staffordshire and Sutherland* (London, 1820), p. X; Staffordshire Record Office, Ref: Sutherland Collection, Chief agent's out letters- 1815, D593/K/1/5/4, Letter to Lord Hardwicke 28th March 1815.

<sup>747</sup> Staffordshire Record Office, Sutherland Collection, Ref: D593/K/1/5/2, Loch to Rennie 7th June 1813.

<sup>748</sup> Loch, J. *Account of the improvements on the estates of the Marquis of Stafford in Shropshire, Staffordshire and Sutherland* (London, 1820), p. 186; Wordie, J. R., *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982), p. 210.

<sup>749</sup> Staffordshire Record Office, Ref: Sutherland Collection, Chief agent's out letters- 1813, D593/K/1/5/2, Loch to Wm Ford (tenant), 24th November 1813.

or utilisation of every field was recorded over a number of years.<sup>750</sup> Maintained by the local agent, they provided a check on the observance by tenants of prescribed cropping regimes and a source of information on relative performances, for example in the case of crop trials. The trialling of different crops and alternative breeds of livestock were undertaken at the Dayhouse Farm and by individual farmers and correspondence files contain references to Black-faced, Cheviot and Merino sheep; to a new strain of barley and to sainfoin and buckwheat as possible alternative crops.<sup>751</sup> Loch encouraged a group of tenants to read Sinclair's book on the agriculture of Scotland and to give a trial to the form of manuring suggested, following which he would discuss its merits with them.<sup>752</sup>

The reorganisation of farm layouts on the Staffords' English estates incorporated farm consolidations, greater regularity given to outline and the construction of new roads to better serve those new layouts. Loch recognised the importance of good roads to farm and estate improvement, a situation highlighted by the reverend Richard Rowley of Oreton near Clun, who complained that the plentiful supplies of lime available from the quarries of the Clee hills were largely unavailable to local farmers due to the 'scandalous badness of the roads.'<sup>753</sup> It was a process Loch had been engaged with at Blair Adam and he acquired a sound understanding of civil engineering techniques, later informing Henry Brougham, 'I have always been a great road Engineer.'<sup>754</sup> Major land drainage lines were laid out across each estate and where possible were established as farm boundaries.<sup>755</sup> New buildings were constructed, located for more efficient operation of the farms, with even the details of their

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<sup>750</sup> Staffordshire Record Office, Ref: Sutherland Collection, D593/N/2/15/20, Trentham Cropping Book .

<sup>751</sup> Staffordshire Record Office, Ref: Sutherland Collection, D593/K/1/3/9 Chief agent's in letters 1821, Wm Lewis to James Loch, 8th October 1821; Ref: D593/K/1/5/9 Chief agent's out letters-1820, Loch to Sellar-Sutherland 4th January 1820.

<sup>752</sup> Staffordshire Record Office, Ref: Sutherland Collection, D593/K/1/5/4, Chief agent's out letters, Loch to Adams, 2<sup>nd</sup> February 1815.

<sup>753</sup> Plymley, J., *General View of the Agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture & Internal Improvement* (London, 1803), p. 234.

<sup>754</sup> Richards, E., *The Leviathan of Wealth* (London, 1973), p.22, 46.

<sup>755</sup> Richards, E., *The Leviathan of Wealth* (London, 1973), p.179.

design receiving Loch's attention.<sup>756</sup> In addition to the most appropriate location for each building, he had considered their organisation: for example the positioning of calf enclosures apropos those of the cows, in order to not cause distress to the cows.<sup>757</sup> He was insistent on the provision of threshing machines and adequate, although not excessive storage space.

To almost every one of the homesteads, is attached a thrashing (sic) machine constructed on the best principles; wherever water could be obtained that has been made use of as the impelling power. Of late some of the more extensive farms have been provided with steam engines for that purpose.<sup>758</sup>

Whether or not Loch was as successful in converting tenants to the use of modern methods and equipment as he claimed, his pursuit of the advancement of agricultural practice on the basis of prevailing informed opinion and the reorganisation of the estates into credible productive units, marks him as a progressive figure of note at this time. Notably, on the English estates the establishment of the structures for change had been effected in a very short period. 'Between 1813 and 1820, changes which can only be described as revolutionary took place in the agrarian no less than in the agricultural organisation of the estates.'<sup>759</sup> However the manner in which he achieved those goals depended not only on his own abilities, acquired knowledge and sense of purpose but relied heavily on the contribution of the community of agents he assembled. William Marshall was described by Loch as one of the best judges of stock in the country: William Lewis had previously been agent to Lord Rollo of Pitcairn and arrived with excellent testimonials; and, for several years before returning to manage the Scottish estates, Francis Suther was well-regarded.<sup>760</sup>

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<sup>756</sup> Staffordshire Record Office, Ref: Sutherland Collection, Chief agent's out letters- 1813, D593/K/1/5/4, Memorandum respecting farm buildings to be erected on Lilleshall estate.

<sup>757</sup> Staffordshire Record Office, Ref: Sutherland Collection, Chief agent's out letters- 1815, D593/K/1/5/4, Memorandum respecting farm buildings to be erected on Lilleshall estate.

<sup>758</sup> Loch, J., *Account of the improvements on the estates of the Marquis of Stafford in Shropshire, Staffordshire and Sutherland* (London, 1820), p. 180.

<sup>759</sup> Wordie, J. R., *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982) p. 212.

<sup>760</sup> Wordie, J. R., *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune* (London, 1982) p. 64.

### 5.5.3 Knowledge dissemination

It seems from exploration of Loch's correspondence that he believed in the primacy of knowledge and its power for enhancement; both of his own capabilities and the betterment of societies, great and small. In the management of the Stafford estates the acquisition of knowledge and its dissemination are fundamental strands in the programme for the improvement of the estates. Dugald Stewart's philosophies on the promulgation of knowledge for the greater good found further expression in Loch's support of his friend Brougham and other radicals such as George Birkbeck and James Mill in the founding of the Society for the Dissemination of Useful Knowledge and the University of London.<sup>761</sup> Loch served as a committee member for SDUK and as a founding council member at the University.<sup>762</sup> His grounding in agriculture and estate management originated from his experiences on the estate of William Adam, whilst the development and utilisation of a network of contacts and his operation in the wider community of improvers proved equally essential to the discharge of his wider role. Loch had management positions on other estates apart from those of the Marquis of Stafford/ Duke of Sutherland. Some, such as those of the Earls of Ellesmere and Carlisle, and the Bridgewater Trustees, had Stafford family connections and the access they afforded provided the opportunity to further enhance his reputation and network of contacts.<sup>763</sup> As the representative of one of the country's wealthiest nobleman he gained access to those that someone in his position may not ordinarily have had, such as Lord Hardwicke and the Duke of Norfolk.<sup>764</sup> He utilised contacts with engineers such as Telford, Jessop, Rennie, and manufacturers such as Samuel Morton of Leith Walk in Edinburgh,

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<sup>761</sup> In future SDUK.

<sup>762</sup> Richards, Eric, 'Loch, James (1780–1855)', *Oxford Dictionary of National Biography* (Oxford, 2004) [<http://www.oxforddnb.com/view/article/16883>].

<sup>763</sup> Wordie, J. R., *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune*, (London, 1982), p. 64; Richards, E., *The Leviathan of Wealth*, London, 1973).

<sup>764</sup> Staffordshire Record Office, Sutherland collection Chief agent's OUT correspondence- 1815, D593/K/1/5/4, Loch to Lord Hardwicke, 28<sup>th</sup> March 1815; Chief agent's OUT correspondence- 1826, D593/K/1/5/22, Loch to Duke of Norfolk, 19<sup>th</sup> December 1826.

mentioned above. In anticipation of the introduction of alternative methods of ploughing to the estates he wrote to the engineer John Rennie (1761-1821) seeking the opinion of his brother George, an agriculturist, on alternative designs for ploughs.<sup>765</sup> It was pursuant of information that inspired correspondence with the engineer Josiah Jessop and a request for a copy of a report he had compiled on the Cromford Railway:

I am very desirous to see the case for the railways stated fairly and reasonably by a person of your science and practical experience and cool judgement. You know I am interested on the other side, but it is my duty if I can to endeavour to make up my mind upon the subject by understanding the real merits of the question...<sup>766</sup>

He also visited the Stockton and Darlington Railway and his report to Captain Robert Bradshaw, manager of Bridgewater Canal, exhibits considerable depth in its analysis (Appendix 5/3).<sup>767</sup> In this and other correspondence he displays the results of engagement in the subject and as demonstrated when he was appointed to Stafford's estate agency, he apprised himself fully of the issues associated with the role.

He visited agricultural estates such as Holkham and Woburn and as part of his promotion of emulation, he encouraged tenants and agents to make visits to other estates and areas.<sup>768</sup> He suggested they allow their sons to spend time learning husbandry at improving estates. In anticipation of his visit to Woburn and Ashridge estates, the Lilleshall agent, William Lewis, wrote to Loch... 'I am very anxious to have an opportunity of viewing the improvements on these great estates you have named.' A month later he wrote with details of what he had seen and his thoughts thereon.<sup>769</sup> In December 1826 Loch confided to the Duke of Norfolk that he was keen to have the son of one of Lord Gower's principal tenants placed with a farmer in that

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<sup>765</sup> Staffordshire Record Office, Sutherland Collection, Ref: D593/K/1/5/2, Loch to Rennie, 7th June 1813.

<sup>766</sup> Staffordshire Record Office, Sutherland Collection, Chief agent's OUT letters 1825, Ref: D593/K/1/5/21, Loch to Wm Jessop- 5th January 1825.

<sup>767</sup> Staffordshire Record Office, Sutherland collection Chief agent's OUT correspondence- 1826 , D593/K/1/5/22, Loch to Capt Bradshaw- 12th October 1826.

<sup>768</sup> Wordie, J. R., *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune*, London, (1982), p.212.

<sup>769</sup> Staffordshire Record Office, Ref: D593/K/1/3/9, Sutherland Collection, Chief agent's IN letters 1821, Lewis to Loch 14th April 1821 & Lewis to Loch 21st May 1821.

part of the country, who is 'well versed in the Norfolk system of Deile husbandry- it is wished that that he should live with the family, but that he should put his hand to everything himself as a workman as there is no other way of teaching a farmer his business.'<sup>770</sup>

Another aspect of the delivery of improvement was his comfort in his own knowledge to be able to give detailed instruction. He instructed Francis Suther, a very accomplished agriculturalist in his own right, in the process of harrowing and rolling of the Park that he wanted Suther to implement. He explained in detail the implications of the process he wanted followed.<sup>771</sup> As has been demonstrated above, Loch was prepared to engage on policy for rotations of crops but he considered the transmission of knowledge to have a two-way flow and he encouraged sub-agents such as William Lewis, to give opinions on farming and matters of management.<sup>772</sup> By so doing he drew on the strength of their previous experience. Loch was also conscious of a wider potential audience, as he imparted to Suther:

I have just got and have been working at Sir John Sinclair's new work "The general report of Scotland" which has an estimable number of valuable facts and is reckoned by Coventry the best of his books and such an account of a country as no other nation possesses. I cannot help thinking however that not one of his plans for farm buildings is at all to be compared with his Lordships (sic) Newstead buildings for convenience of arrangement. I am very desirous to send him and Ld Hardwicke a copy of the plan in order that it may be generally known and put into the general report of England when it appears.<sup>773</sup>

In his subsequent letter to Lord Hardwicke of 28th March 1815 Loch included a sketch of a set of farm buildings which had been erected upon a farm on the Trentham Estate. He advised of the benefit to the tenant farmer and how 'features adopted in the North have been combined with those that a better climate and different course of husbandry has made

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<sup>770</sup> Staffordshire Record Office, Sutherland/Stafford collection Chief agent's OUT correspondence- 1826, Ref: D593/K/1/5/22, Loch to Duke of Norfolk-Dec 19th 1826.

<sup>771</sup> Staffordshire Record Office, Sutherland Collection, Chief agents out letters- 1815, D593/K/1/5/4, Loch to Suther 13th April 1815.

<sup>772</sup> Staffordshire Record Office, Sutherland Collection, Chief agent's IN letters 1821, StRO Ref: D593/K/1/3/9, Wm Lewis to James Loch 8th Oct 1821.

<sup>773</sup> Staffordshire Record Office, Sutherland Collection, Chief agent's Out Letters- 1815 Ref: D593/K/1/5/4, James Loch to Mr Suther (under agent) 21 Jan 1815.

prevalent in England.’ Having elaborated on the change being effected, Loch concluded that the purpose of his letter was to pass on knowledge of the improvements being undertaken so that they may be considered with similar being undertaken in other parts of the country.<sup>774</sup>

The publicity to be gained through the media of the Board of Agriculture, journals such as *Annals of Agriculture*, or the landed networks would undoubtedly be pleasing to Lord Stafford and beneficial to Loch’s stature and self-esteem.

Loch was clearly aspirational, as he repeatedly demonstrated but as a nineteenth-century Whig gentleman, his actions must be judged in that context. He was driven by a sense of duty but in the context of established social structures he was also interested in the promotion of betterment for the less fortunate. It was implicit in Loch’s character that he would seek out greater knowledge on those issues that interested him or served the interests of his employer so that he was better informed when making judgements, giving advice or instruction. To this end he sought out the sources able to better advise him; visited locations such as landed estates and railways, to witness and experience them at first-hand. He was mindful of the need existing in others for knowledge, to enable them to satisfactorily perform their own roles. He also corresponded in pursuit of information and to proffer his opinions.<sup>775</sup> In the process he established a network of contacts and the acquisition and dissemination of knowledge arising from that intellectual community was a decisive factor in the placement of the Stafford estates in a position to progress into the phase of ‘high farming’ in the middle of the nineteenth-century. The agricultural improvements that Loch wrought on the English estates of the Stafford family were, as Wordie contends, not only impressive in the extent of the change

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<sup>774</sup> Staffordshire Record Office, Sutherland Collection, Chief agent's out letters- 1815, Ref D593/K/1/5/4, James Loch to Lord Hardwicke, 28<sup>th</sup> March 1815.

<sup>775</sup> Staffordshire Record Office, Ref: Sutherland Collection, D593/K/1/5/21, Chief agent’s OUT letters 1825, Loch to Josiah Jessop, 5<sup>th</sup> January 1825; D593/K/1/5/22, Chief agents OUT letters, 1826, Loch to Capt Bradshaw, Liverpool and Manchester Railway, 29<sup>th</sup> July 1826 and 12<sup>th</sup> October 1826; Loch to Mr Wilson re Troon and Kilmarnock railway, 3<sup>rd</sup> November 1826.

achieved but more so in view of the ‘very short space of time in which they were carried out.’<sup>776</sup>

## 5.6 Conclusion

Agricultural improvement in Shropshire in the second half of the eighteenth-century was limited in its extent: constrained by the physical characteristics of large areas of farming land, prevailing agricultural knowledge and frequently impassable state of the roads. It was a state that was not, however, unique to Shropshire. A few areas of common land and wastes had been enclosed and brought into production through drainage and extensive fertilisation and elements of improving activity were to be found in scattered areas of the county. The light soils of the eastern part of the county witnessed the application of new techniques and thinking and by the turn of the century the ‘spirit of improvement’ was being excited in those areas by the formation of the first agricultural societies. Elsewhere, alternative crops and rotations were being gradually introduced and some evidence of new breeds of livestock exists. John Ashby, the agent to Lord Clive in the 1770s, had a progressive attitude to estate management and may have found inspiration in the writing of Enlightenment philosophers, whilst the radical ideas of Edward Harries of Benthall concerning the lot of the agricultural labourers were married to the adoption of current modes of husbandry.<sup>777</sup> Harries had an ironworks on his Benthall estate and in 1787 allowed Lord Dundonald to install coke stoves there for the extraction of tar.<sup>778</sup> An original subscriber to the iconic ‘Iron Bridge’ constructed in the Severn Gorge, Harries displays enlightenment credentials in a variety of ways: he combines at an early stage, the innovative aspects of industrialisation, agricultural and social improvement.

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<sup>776</sup> Wordie, J. R., *Estate management in Eighteenth-century England: the building of the Leveson-Gower Fortune*, London, (1982), p.213.

<sup>777</sup> Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 70.

<sup>778</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p. 75.

In some instances the state of war from 1793, with the threat of invasion and the steep rise in grain prices, promoted enthusiasm for improvement, as opposed to outright economic opportunism; the adoption of new or revised implements were being taken up, although cautiously; and knowledge dissemination through emulation, publications and creation of a handful of agricultural societies, continued through the 1820s. What is apparent is that prior to this time there was little wide-scale rush to improvement and displays of Enlightenment ideals are irregular.

The enlightened philosophies of Dugald Stewart are, however, identifiable in the actions of Loch. His programme for the structural reorganisation of the estates can be seen to be indirectly attempting to address the moral conflict between the creation of wealth and advancement for the common good. Whether or not he was entirely successful, particularly in Scotland, he professed the desire to enhance the welfare of the tenants of the estates whilst furthering the interest of his employer. Stewart's 'moral citizenship' may be wrapped up with the sense of duty and responsibility that he personally portrayed and sought to instil in his sub-agents and tenants: responsibility to meet one's obligations of status or personal commitment and concern for the less fortunate. The advancement of society through the diffusion of knowledge found its expression in Loch's encouragement of tenants to embrace improvement: transforming their understanding of alternative methods through a variety of means and sources. On other estates any philosophical rationalisation through which Childe, Hill, Cotes and others pursued improvement and in some instances enhanced the localities around their estates, is not so apparent. Whilst a spirit of improvement may be identified in these circumstances attribution of Enlightenment ideals is more difficult to apply.

## Chapter 6: Improvement and the cultural expressions of the Enlightenment impulse in Shropshire

### 6.1 Introduction

A belief in self-improvement was expressed by the civil engineer, Matthew Davidson, in a letter to his son Thomas:

I know of no other way to widen the field of rational enjoyment, but by the acquisition of useful knowledge, this is a fund of happiness which the ignorant man can never taste, indeed I look upon ignorance as criminal, where there has been any opportunity for information.<sup>779</sup>

By mid-eighteenth-century a particularly English form of empirical science had emerged that became a determinant of the shape of English enlightenment and through advancement of knowledge of the natural world, a stimulus to the spirit of improvement. In this final substantive chapter, the manner in which science found cultural expression in Shropshire is explored.<sup>780</sup>

The reason for its emergence in this form has been debated by historians from different disciplines, recently by the economic historian Joel Mokyr.<sup>781</sup> Porter argues that the role of industrialists was not as widely determinative as previously proclaimed; that science as a cultural form attracted those, particularly in the provinces, pursuing their own embodiment of Enlightenment.<sup>782</sup> Jacob presents a modified perspective, declaring that, 'scientific acumen was not just cultural capital, it was also deployed and given industrial application,' its

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<sup>779</sup> Ironbridge Gorge Museum Library, Mathew Davidson Correspondence, Copy letter book 1795-1818 (136 letters), Ref: DMD8- Acc No 1992.14918, Matthew Davidson to Thomas Davidson, Oswestry, 21<sup>st</sup> February 1813.

<sup>780</sup> Porter, R., 'Science, provincial culture and public opinion in Enlightenment England,' in Borsay, P., (ed.), *The eighteenth-century town: a reader in English Urban History, 1688-1820* (London, 1990), pp.243-267; Inkster, I., 'The development of a scientific community in Sheffield, 1790-1850,' in *Scientific Culture and Urbanisation in Industrialising Britain* (Aldershot, 1997), pp. 99-131, p. 99;

<sup>781</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009).

<sup>782</sup> Porter, R., 'Science, provincial culture and public opinion in Enlightenment England,' in Borsay, P., (ed.), *The eighteenth-century town: a reader in English Urban History, 1688-1820* (London, 1990), pp.243-267, p. 251.

practical utilisation bringing ‘prestige’ to the perpetrator.<sup>783</sup> Such diversity of opinion can often be accommodated within the ambit of local variability. Ian Inkster has written of the scientific community emerging in Sheffield around the turn of the nineteenth-century and recently Jones and Elliott have explored contemporary science culture in the west midlands and Derbyshire respectively. In these studies local similarities and distinctions in the course of cultural Enlightenment, emerge.<sup>784</sup> This study offers a perspective on Shropshire within the same period and what becomes apparent through the work underpinning these studies is that delineation of character based upon geographical, economic or functional categorisation is not secure. Neither is there uniformity of process between industrial towns any more than there is between county towns or between rural counties. It is only with the continuation of localised studies that a clearer overall picture of the development of an English Enlightenment will be apparent.

Enthusiasm for self-improvement and the acquisition of science-based knowledge; desire for the possession of scientific impedimenta; aspiration for social amelioration; opportunity for women to broaden their intellectual and social horizons and the adoption of modish sentiments, are all viewed by historians of science as manifestations of the appetite for scientific knowledge and the integration of natural philosophy into contemporary cultural paradigms.<sup>785</sup> The means of knowledge transfer was progressively augmented, with enhancement to transport infrastructure improving travel and the conveyance of goods, the growth in provision of printed matter and an escalation in the adoption of epistolary

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<sup>783</sup> Jacob, M. C., 'Mechanical science on the factory floor: the early industrial revolution in Leeds,' in *History of Science*, xlv, 2 (June 2007), pp. 197-221, p. 211.

<sup>784</sup> Inkster, I., 'The development of a scientific community in Sheffield, 1790-1850,' in *Scientific Culture and Urbanisation in Industrialising Britain* (Aldershot, 1997), pp. 99-131; Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009); Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850*, (Manchester, 2009).

<sup>785</sup> Jacob, M. C. and Stewart, L., *Practical Matter: Newton's science in the service of industry and Empire, 1687-1851* (Cambridge, Mass., 2004).

communication.<sup>786</sup> Personal association frequently afforded the opportunity for the discussion of science-related issues both through the agency of formal organisations or in social environments, as the diaries of Katherine Plymley exemplify.<sup>787</sup> In comments on Mokyr's *Industrial Enlightenment*, Maxine Berg makes reference to 'the self-sustaining process of improvement' arising from the activities of artisans engaged in the transfer of knowledge and a similar state is observable in both the contemporary adoption of cultural pursuits and programmes of self-improvement.<sup>788</sup> The increasing accessibility of knowledge forms for women and the 'lower orders' created a wider user-base through which knowledge would be disseminated and the extent to which it is identifiable in the cultural interests of Shropshire's inhabitants is, in the former context, the subject of the included case-study.

In view of its cultural prominence, the manner in which public science featured in the lives of contemporary Salopians and contributed to expressions of Enlightenment ideals and improvement represents the nucleus of the chapter. As with the other substantive chapters, the chapter considers the extent to which intellectual communities and associational behaviour promoted improvement. It also explores the degree to which correspondence, through the medium of what became known as the 'Republic of Letters,' was employed by Shropshire men and women in a cultural context.<sup>789</sup> As indicated above, the abstract nature of knowledge determines that it cannot be constrained by artificial boundaries and attention will be drawn to examples of the links sustained by those with cultural interests in natural philosophy in wider regional or dispersed philosophical circles. Ruth Watts' view of the contemporary lack of clarity between practitioners of 'serious' science and those who engaged in recreational

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<sup>786</sup> Jacob, M. C. and Stewart, L., *Practical Matter: Newton's science in the service of industry and Empire, 1687-1851*, (Cambridge, Mass., 2004).

<sup>787</sup> Shropshire Archives, Ref: 1066/, Corbett of Longnor Collection, 'Katherine Plymley's Journals.'

<sup>788</sup> Berg, M., *The genesis of useful knowledge, History of science*, xlv, 2007, p. 129.

<sup>789</sup> The origins of the expression 'The Republic of Letters' are frequently accredited to the philosopher Pierre Bayle and his journal *Nouvelles de la République des Lettres (1664)*, although references to its fifteenth-century usage in Italian (*Repubblica letteraria*) exist.

activity, as either provider or consumer, offers a frame of reference for the examination of their activities and the strength of such assertions is tested in this chapter.<sup>790</sup>

## 6.2 The influence of public science upon cultural paradigms

By the middle years of the eighteenth-century the developmental momentum of natural philosophy had shifted from a metropolitan base to the provinces, owed in great part to the explications and demonstrations of itinerant lecturers.<sup>791</sup> In the first half of the century John Harris, William Whiston, the two Francis Hauksbees and John T. Desaguliers were formative influences in the establishment of a cultural desire to acquire scientific knowledge.<sup>792</sup>

Desaguliers, the chief demonstrator at the Royal Society, remarked that things rationalised by means of the senses were so much better understood than by application solely to books.<sup>793</sup> It was a theme that Joseph Priestley was to later articulate in the 1770s and 1780s, referring to a great difference existing between reading about experiments and witnessing their execution.<sup>794</sup> As a consequence of them communicating the latest developments in scientific understanding, the itinerant lecturers fostered a widespread interest in what may be considered as ‘public science’ and ‘polite learning’ in the regions.<sup>795</sup> In a cultural sense, the assimilation of scientific and technical knowledge was not therefore the preserve of industrialists or the artisan classes; it encompassed the gentry, lawyers, doctors, clergymen and shopkeepers. Studies of provincial scientific practice point to what may appear to be distinctions of geography, local economies or social stratification but are essential in understanding the complexity of English enlightenment.

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<sup>790</sup> Watts, R., *Women in science: a social and cultural history* (London, 2007), p. 61; Bruton, R. N., *An examination of the extent to which scientific lecturers were contributing to the dissemination of knowledge in the mid-eighteenth-century West Midlands* (2009), unpublished MA dissertation (University of Birmingham, 2009).

<sup>791</sup> Sutton, G. V., *Science for a polite society: Gender culture and the demonstration of Enlightenment* (Oxford, 1995), p. 192.

<sup>792</sup> Dobbs, E. J. Teeter and Jacob, M. C., *Newton and the culture of Newtonianism* (New York, 1998).

<sup>793</sup> Desaguliers, J. T., *A course of mechanical and experimental philosophy* (London, 1725), cited by Stewart, *The rise of public science: rhetoric, technology and natural philosophy in Newtonian Britain, 1660-1750* (Cambridge, 1992), p. 125.

<sup>794</sup> Schofield, R. E., *A scientific autobiography of Joseph Priestley (1733-1804)* (Massachusetts, 1966); Priestley, J., *Experiments and observations*, vol. 2, (1775-7, II.) p. xxxiv.

<sup>795</sup> Elliott, P., ‘The origins of the ‘creative class:’ Provincial urban society, scientific culture and socio-political marginality in Britain in the eighteenth and nineteenth centuries,’ *Social History*, Vol. 28, No. 3, (2003), pp. 361-87, p. 362.

The apparent significance of doctors or those with a degree of medical training, in local manifestations of enlightened activity, have been highlighted by Torrens in respect of the Bath Philosophical Society and by Elliott with regard to Nottingham and the Derby Philosophical Society.<sup>796</sup> Eight out of twenty resident members of the Derby Philosophical Society up until the death of its principal founder, Erasmus Darwin (1731-1802) and sixteen of thirty-two non-residents were doctors.<sup>797</sup> Amongst members of the Lunar Society of Birmingham, Darwin, Small, Keir, Withering and Stokes were medically trained and pursued a variety of enlightened interests, both individually and in concert with others. With enquiring minds and imbued by medical and scientific training, doctors were frequently involved in philosophical activities. The cleric and philosopher Thomas Gisborne (1758-1846) commented that there was merit in a doctor bestowing 'a due share of his time on other collateral pursuits and acquisitions, as chemistry, botany, and natural philosophy,' given their close association with 'the healing art.'<sup>798</sup> Gisborne's suggestion is of a social imperative to such action rather than the presence of any prevailing cultural precedent. But that would not be the cause for denial of any exercise of enlightened thinking. By the 1830s specialisation in scientific discipline was well-established and more subject-specific focus was occasioned in intellectual communities. Michael Brown considers that a move towards more rigidity was demonstrated in the case of the medical profession, with intellectual communities being directly tied to medical matters and fellow practitioners.<sup>799</sup> In this scenario the diversity of influences and contacts would be therefore restricted.

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<sup>796</sup> Torrens, H. S., 'Geological communication in the Bath area in the last half of the eighteenth century,' in Jordanova, L. and Porter, R. S. (eds), *Images of the earth: Essays in the History of the Environmental Sciences* (Chalfont St Giles, 1979), pp. 215-247, p. 233; Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850*, (Manchester, 2009), p. 76.

<sup>797</sup> Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850*, (Manchester, 2009), p. 76.

<sup>798</sup> Gisborne, T., 'An enquiry into the duties of men in the higher rank and middle classes of society in Great Britain, resulting from their respective stations...' (London, 1794), p. 388.

<sup>799</sup> Brown, M., 'Medicine, Reform and the 'end' of Charity in Early Nineteenth-century England,' *English Historical Review* (2009), pp. 1353-1388. p. 1384.

Thomas Dugard (1777-1840), physician at the Shropshire Infirmary, exemplifies the interest of members of the medical fraternity in the pursuit of Enlightenment knowledge. Katherine Plymley described him as ‘an excellent chemist...a good botanist; he has rather a large collection of plants and minerals and loves natural history in all its branches.’<sup>800</sup> He presented a series of eight lectures on chemistry to an audience of some seventy people at the Infirmary from 23<sup>rd</sup> March to 27<sup>th</sup> April 1804.<sup>801</sup> The presence of female and younger members of the Plymley family indicate a mixed audience for the course, which undoubtedly represented a combination of social entertainment and the exposition of aspects of contemporary science knowledge, in keeping with the contemporary enlightenment ethos. The entertainment value and audience structures for lectures are explored further in the following section of the chapter. DuGard was a keen mineralogist and in the minute book of the Shropshire and North Wales Natural History Society he is recorded as a vice-president and the curator of geology.<sup>802</sup> Extant evidence of the cultural interests of contemporary Shropshire doctors is however limited. Robert Waring Darwin (1766-1848) had an interest in botany, as did Joseph Babington (1768-1826), who contributed to Plymley’s *General View*.<sup>803</sup> Surprisingly in 1835 there were only five medical men identifiable in the list of 174 members of the newly formed Shropshire and North Wales Natural History Society, namely Thomas Dugard, G. J. Drury, James Proud Johnson, Henry Johnson and J. W. Wilson.<sup>804</sup> By comparison twenty-nine ordained clerics and nine females had paid their subscriptions.

Eighteenth-century debates explored the acceptability of the study of natural philosophy within the context of popular religious beliefs and by the early nineteenth-century the

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<sup>800</sup> Shropshire Archives, Ref: 1066/ 60, Corbett of Longnor Collection, ‘Katherine Plymley's Journals’, 13<sup>th</sup> April 1802.

<sup>801</sup> Shropshire Archives, Ref: 1066/ 62, Corbett of Longnor Collection, ‘Katherine Plymley's Journals’, 4<sup>th</sup> May 1804.

<sup>802</sup> Shropshire Archives, Ref: 1066/ 72, Corbett of Longnor Collection, ‘Katherine Plymley's Journals’, 4<sup>th</sup> Sept 1807; Ref: 6001/52/180, Shropshire & North Wales Natural History Society Minute Book (1835-1850).

<sup>803</sup> Shropshire Archives, Ref: 1066/ 78, Corbett of Longnor Collection, ‘Katherine Plymley's Journals’, 27<sup>th</sup> Aug 1809; Plymley, J., *A general view of the agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture and internal improvement*, (London, 1803), p. 183.

<sup>804</sup> Shropshire Archives, Ref: 6001/52/180, Shropshire & North Wales Natural History Society Minute Book (1835-1850).

contribution of members of the clergy to public science was substantial.<sup>805</sup> Discourses within social theory and historiography have debated Richard Merton's thesis concerning the apparent over-representation of Protestant clerics within contemporary natural philosophy.<sup>806</sup> He regarded the nature of fundamental Protestant values to be a determining factor in such engagement and for the growth of science in the seventeenth and eighteenth centuries. Merton considered that 'empiricism, rationalism, utilitarianism and intellectual autonomy' were encompassed by fundamental Protestant tenets.<sup>807</sup> In a comparative study on the respective contributions of Protestant and Catholic clergy to German Enlightenment science, Becker disagrees. He concludes that social and cultural factors contribute more to scientific engagement of churchmen than any religious conditioning: 'cultural capital' as reflected in Becker's study by university attendance; 'social capital' (the socio-political power of social circles the individual is active within); and family relationships, all serving to stimulate any drive for cultural engagement.<sup>808</sup> Such considerations, however, equally apply to the non-clerical population afforded comparable social and cultural access and do not therefore explain the apparent preponderance of clergymen pursuing scientific knowledge. Elements in the advancement of understanding of the natural world were new, they were exciting, expressed interest in them was fashionable and they opened doors to other worlds. Members of the clergy were not immune from such attractions and natural history and geology were considered socially acceptable forms of activity for clerics.

The study of science in subjects such as geology and mineralogy was widely pursued in areas where mining and mineral extraction prevailed, Shropshire being a case in point. They

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<sup>805</sup> Watts, R., *Women in science: a social and cultural history* (Abingdon, 2007), p. 58.

<sup>806</sup> Merton, R.K., 'Puritanism, pietism and science, *Social theory and social structure* (New York, revised edition 1957, original 1936), pp. 628-660.

<sup>807</sup> Becker, G., 'Challenging Merton's Protestantism-Science hypothesis: the historical impact of sacerdotal celibacy on German science and scholarship,' *Journal for the scientific study of religion*, 2011, vol. 50 (2), pp. 351-365, p.351.

<sup>808</sup> Becker, G., 'Challenging Merton's Protestantism-Science hypothesis: the historical impact of sacerdotal celibacy on German science and scholarship,' *Journal for the scientific study of religion*, 2011, vol. 50 (2), pp. 351-365, p.351.

afforded the opportunity for the furtherance of knowledge that bore potential economic benefit to those industrialists engaged in iron production or mining, for example, but were frequently adopted by those same businessmen as a cultural pursuit.<sup>809</sup> In Shropshire the ironmaster and mine operator William Reynolds had a keen interest in minerals, reputedly rewarding his employees for bringing items of potential interest to his attention.<sup>810</sup> His cultural interest in science however extended beyond geology. He had studied science at Edinburgh under James Watt's mentor, Joseph Black.<sup>811</sup> He experimented with electricity and read Priestley's publications and included details of his experiments in his correspondence with his cousin, William Rathbone.<sup>812</sup> Watt wrote to Reynolds: 'I am glad to hear that I have at last got a fellow labourer in the pneumaticle vineyard. I mean in the chemical part...'. His letter included three pages of notes on chemistry, ending with an invitation to Reynolds to visit in order to discuss more chemistry.<sup>813</sup> In 1800 Reynolds became a 'proprietor' of the Royal Institution in London and began experimentation with nitrous oxide, both situations undoubtedly arising from his long-term friendship with the Shropshire-born Dr Thomas Beddoes.<sup>814</sup> Beddoes and his assistant Humphry Davy had isolated nitrous oxide gas and experimented upon its effects before Davy was attracted to join the nascent Royal Institution in 1801.<sup>815</sup> The study of rocks and fossils was not, however, the exclusive domain of industrialists: Robert Townson (1762-1827), was a naturalist and traveller who had family connections in the county and wrote a number of works during his residence in Shropshire; Thomas Dugard was not only an able chemist but similarly pursued a fascination with all

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<sup>809</sup> Elliott, P., *Enlightenment, modernity and Science: geographies of scientific culture and improvement in Georgian England* (London, 2010), p. 183.

<sup>810</sup> Torrens, H. S., 'The Reynolds-Anstice Shropshire geological collection, 1776-1981,' *Archives of Natural History*, (1982), 10 (3): 429-441, p. 430; Trinder, B., *The Industrial Revolution in Shropshire* (London, 2000), p. 106; Raistrick, A., *Dynasty of ironfounders* (London, 1953), p. 93.

<sup>811</sup> Raistrick, A., *Dynasty of ironfounders* (London, 1953), p. 93.

<sup>812</sup> Raistrick, A., *Dynasty of Ironfounders* (London. 1953), p. 93.

<sup>813</sup> Birmingham Archives and Heritage, Archive of Soho, Ref: MS3219/4/124/218, James Watt to Wm Reynolds, 25<sup>th</sup> Dec 1795.

<sup>814</sup> *Archives of the Royal Institution of Great Britain in facsimile*, Vol 2 (London, 1971) cited in Torrens, H. S., 'The Reynolds-Anstice Shropshire geological collection, 1776-1981,' *Archives of Natural History*, (1982), 10 (3): pp. 429-441, p. 431; Birmingham Archives and Heritage, 'Letter from T. Beddoes...on the experiments made at the Royal Institution with the nitrous oxide,' *Nicholsons Journal*, Vol. 4, pp. 75-76.

<sup>815</sup> Jay, M. *The Atmosphere of Heaven: the unnatural experiments of Dr Beddoes and his sons of genius* (London, 2009), p. 225.

aspects of natural history and botany; Thomas Netherton Parker (1772-1848) was a landowner, agricultural improver and Sheriff of Shropshire in 1815 and all were amongst a growing cohort of individuals in Shropshire engaged by the subject of geology and mineralogy.<sup>816</sup> It became the fastest growing science specialisation in Britain in the period around the turn of the century and epitomised the expanding awareness of self-improvement. The itinerant lecturer Benjamin Martin (bap1705-1782) wrote: ‘we have opened to our minds the wondrous laboratory of nature, and the stupendous processes therein carrying on, unheeded and unthought-of by the vulgar.’<sup>817</sup>

The manner in which public science became absorbed into cultural paradigms was very much determined by local circumstances and Elliott considers that the provincial literary and philosophical societies represented a primary influence on the progression and shape of Enlightenment culture in Britain.<sup>818</sup> To an extent Elliott is following Crosland’s maxim of 1977, ‘to study institutions,’ in order to ascertain the progress of intellectual life and its local variations.<sup>819</sup> This approach presupposes that intellectual communities were largely formalised bodies and leaves little room for the variety of intellectual association that stimulated contemporary social, cultural or economic study of science. It also ignores issues of timing: literary and philosophical societies were founded throughout the period between 1781 and the 1850s and appear at different stages of local economic development. There is consequently no perceivable consistency in the influence of individual societies on the form of local manifestations of public science and the progress of development. As a consequence the study of individual local societies offers greater prospects for understanding the dynamics

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<sup>816</sup> Torrens, H. S., ‘Townson, Robert (1762–1827)’, *Oxford Dictionary of National Biography*, 2004, <http://www.oxforddnb.com/view/article/27639>; Shropshire Archives, Ref: 1066/72, Corbett of Longnor Collection, ‘Katherine Plymley’s Journals’; Refs: 1066/72, 27<sup>th</sup> Aug 1807 & 28<sup>th</sup> Oct 1807, 1066/73, 30<sup>th</sup> Oct 1807, 1066/60, 13<sup>th</sup> Apr 1802; Ref: 665/3/1302, ‘Cuttings from Shrewsbury Chronicle re Shropshire Agricultural Society Annual Show’ (1817); Ref: 6001/134, ‘Volume of letters relating to Shropshire and North Wales Natural History and Antiquarian Society, pp. 22-3; Torrens, H. S., *The practice of British Geology* (Aldershot, 2002), p. 144;

<sup>817</sup> Millburn, J., *Benjamin Martin: author, Instrument maker and county showman* (Leyden, 1976), p. 61.

<sup>818</sup> Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850*, (Manchester, 2009), p. 9.

<sup>819</sup> Crosland, M., ‘History of science in a national context,’ *British Journal for the history of science*, 1977, 10, 95-113.

of the absorption of public science into contemporary culture. More recent work has also recognised the contributory importance of informal association and of subject-specific organisations to the establishment of cultural paradigms.<sup>820</sup>

Within the larger industrial conurbations the direction of scientific activity was extensively driven by utilitarian needs or opportunities.<sup>821</sup> The full extent of philosophical pursuits within those towns, however, went beyond the purely utilitarian and philosophical societies were neither ubiquitous nor functionally uniform. It is appropriate to consider examples. Despite the adaptation of science being contributory to the progression of industrialisation in Manchester, within the Literary and Philosophical Society, utilitarianism gave way to the cultural aspirations of middle-ranking individuals such as doctors.<sup>822</sup> Of the twenty-four founding members of the Society, fourteen were known to be doctors and only two were manufacturers, which reflected in the aspects of ‘natural knowledge’ undertaken by members.<sup>823</sup> A subscriber with manufacturing interests such as Thomas Henry was drawn to publish on subjects including meteorology, chemistry, medicine, mechanics and even biography.<sup>824</sup> Local specificity and conflicting pressures between the pursuit of science and the maintenance of the library prevailed in the Newcastle Literary and Philosophical Society. Opposing factions undermined the original intentions of the founder William Turner (1761-1859).<sup>825</sup> In an endeavour to continue the encouragement of philosophical study, Turner was

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<sup>820</sup> For example: Elliott, P. A., *Enlightenment, modernity and Science: geographies of scientific culture and improvement in Georgian England*, (London, 2010); Jacob, M. C., ‘Mechanical science on the factory floor: the early industrial revolution in Leeds,’ in *History of Science*, xlv, 2 (June 2007), pp. 197-221; Smout, T. C. ‘A new look at the Scottish Improvers,’ in *The Scottish History Review*, Vol. 91: No 231, April 2012, pp. 125-149.

<sup>821</sup> Inkster, I., ‘The development of a scientific community in Sheffield, 1790-1850,’ in *Scientific Culture and Urbanisation in Industrialising Britain*, Ashgate, Aldershot, 1997, pp. 99-131.

<sup>822</sup> Porter, R., ‘Science, provincial culture and public opinion in Enlightenment England,’ in Borsay, P., (ed.), *The eighteenth-century town: a reader in English Urban History, 1688-1820* (London, 1990), pp.243-267, p. 263; Thackray, A., ‘Natural knowledge in cultural context: the Manchester mode,’ *American Historical Review*, Vol. 79, No 3, 1974, pp 672-709, p. 688.

<sup>823</sup> Thackray, A., ‘Natural knowledge in cultural context: the Manchester mode,’ *American Historical Review*, Vol. 79, No 3, 1974, pp 672-709, p. 688.

<sup>824</sup> Thackray, A., ‘Natural knowledge in cultural context: the Manchester mode,’ *American Historical Review*, Vol. 79, No 3, 1974, pp 672-709, p. 698.

<sup>825</sup> Porter, R., ‘Science, provincial culture and public opinion in Enlightenment England,’ in Borsay, P., (ed.), *The eighteenth-century town: a reader in English Urban History, 1688-1820* (London, 1990), pp.243-267, p. 263; Inkster, I., and Morrell, J., *Metropolis and Province, science in British culture* (London, 1983), p.211.

prominent in the formation of alternative associations within the locality: in particular the New Institution (1802), the Society of Antiquaries in Newcastle-upon-Tyne (1813) and the Natural History Society (1829).<sup>826</sup> Sheffield, another major industrial town, witnessed the onset of significant industrial growth from the middle of the eighteenth-century yet did not possess a Literary and Philosophical Society until 1822. Inkster has pointed out that despite this apparent deficiency, scientific interests were pursued and itinerant lecturers were regular visitors to the town.<sup>827</sup> Whilst the devotees of science in Sheffield explored a wide-range of subjects, geology and botany were not as prevalent as in counties such as Shropshire and Derbyshire, their interest being largely directed towards the ‘mechanical arts’ and chemistry which served the interests of the local industrialists.<sup>828</sup> Even in an informal association such as the Lunar Society in Birmingham, the members were frequently pursuing advances in knowledge that may afford business opportunities whilst their interests extended into cultural forms of philosophical endeavour.<sup>829</sup> Visitors came or were invited to Soho and knowledge was exchanged through personal connection and correspondence networks, establishing what Jones describes as ‘the vascular system’ of knowledge transmission.<sup>830</sup>

Within county or market towns where industrial development was less pronounced, the utilitarian demands on natural philosophy gave way to alternative stimuli and institutional activity. County towns had civic, social or economic affinities, one to another, but frequently differed in the form of cultural expression, timing of the establishment of philosophical societies and their functional organisation. Derby Philosophical Society was founded in 1784, largely on the intellectual strength of its social elite which included Erasmus Darwin, the

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<sup>826</sup> Webb, R. K., ‘William Turner (1761-1859), *Oxford dictionary of national biography* (Oxford, 2004).

<sup>827</sup> Inkster, I., ‘the development of a scientific community in Sheffield, 1790-1850,’ (Originally published 1973), in *Scientific culture and urbanisation in industrialising Britain* (Aldershot, 1977), p. 105.

<sup>828</sup> Inkster, I., ‘the development of a scientific community in Sheffield, 1790-1850,’ (Originally published 1973), in *Scientific culture and urbanisation in industrialising Britain* (Aldershot, 1977), p. 112.

<sup>829</sup> Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009), p. 71, 92.

<sup>830</sup> Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009), p. 72.

former Lunar Society member, the cleric and philosopher Thomas Gisborne, the mill owner and designer William Strutt and as highlighted above, almost half of the Society's membership consisted of medical practitioners who had experienced education in science.<sup>831</sup> Frequently the civic functions borne by county towns, such as local governance and assizes, dictated the social structures prevalent in individual towns.<sup>832</sup> The presence of professional men and members of the landed elite formulated the direction of cultural interests, often in isolation from any institutional contribution. In Shropshire, for example, the 2<sup>nd</sup> Marquis of Stafford had an interest in botany and chemistry, Rowland Hunt JP of Boreatton had, in addition to volumes on agriculture, some twenty works on the sciences and the MP Robert Aglionby Slaney made regular entries in his diaries on botanical matters. The absence of a literary and philosophical society in Shropshire until 1830s should not of itself therefore be considered indicative of a lack of cultural science activity. Inkster comments that, 'it is precisely during periods of rampant social and economic change...that formalized institutions fail to "reflect" new social values, needs and groupings.'<sup>833</sup> It is therefore the examination of non-institutional examples of knowledge dissemination that casts light on the process of improvement and changes in cultural paradigms.

### **6.3 The dissemination of scientific knowledge**

In the first lecture to be given to the Leeds Literary and Philosophic Society in 1821 Charles Thackrah declaimed, 'the thirst for improvement gives an exaltation of character...produce(s) the works of genius and the discoveries of science,...science, no longer confined to the closets

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<sup>831</sup> Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850* (Manchester, 2009), p. 75.

<sup>832</sup> Elliott, P., *Enlightenment, modernity and Science: geographies of scientific culture and improvement in Georgian England* (London, 2010), p. 187.

<sup>833</sup> Inkster, I., *Scientific Culture and Urbanisation in Industrialising Britain* (Aldershot, 1997), p. 82.

of the learned is applied to the comforts and amelioration of mankind. Its influence is strikingly apparent alike in our houses and manufactories.<sup>834</sup>

In the 1990s there was a view that the process of popularisation of science originated with its adoption or pursuit by elite groups and progressively passed down, generally in diluted form to lower social orders.<sup>835</sup> Such an approach, however, denied the positive adoption of cultural science by individuals in all social strata as either an Enlightenment form or as exemplification of the application of the concept of improvement in a personal context.<sup>836</sup> It did not accommodate issues associated with local variability and the individual. More recent studies have re-examined contemporary dynamics of change within natural philosophy and science, on a sectoral or geographical basis. The utilisation of Habermas's concept of a 'public sphere' in achieving insight into dissemination of knowledge and the recognition of the importance of 'private spheres' applied in a similar context within the domestic environment, have led to greater understanding of how science became a driving force in eighteenth and early nineteenth-century economic and cultural development.<sup>837</sup> The broadening of public science activity and its migration from metrocentric roots into the regions began to take shape around the end of the first quarter of the eighteenth-century. As noted above the itinerant lecturers were principal agents of change.

### 6.3.1 Itinerant science lecturers

Among the earliest-identified lecturers active in the provinces was Benjamin Martin. A former schoolmaster and a writer, he ultimately had more than eighty titles to his name and was lecturing on science by 1742 and giving lectures across the southern counties and the

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<sup>834</sup> Thackrah, C., *An introductory discourse. Delivered to Leeds Philosophical and Literary Society, April 6<sup>th</sup>, 1821* (Leeds, 1821), pp. 23-4, cited in Jacob, M. C., 'Mechanical science on the factory floor: the early industrial revolution in Leeds,' in *History of Science*, xlv, 2 (June 2007), p. 211.

<sup>835</sup> Cooter, R., and Pumfrey, S., 'Separate spheres and public places: reflections on the history of science popularisation and science in popular culture,' *History of science*, 32:3 (Sept 1994), 237-267, p. 248.

<sup>836</sup> Cooter, R., and Pumfrey, S., 'Separate spheres and public places: reflections on the history of science popularisation and science in popular culture,' *History of science*, 32:3 (Sept 1994), 237-267, p. 251.

<sup>837</sup> Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850*, (Manchester, 2009), pp. 5-6.

Midlands during the following ten years.<sup>838</sup> The first advertisement identifying his presence in the region appeared in *Aris's Birmingham Gazette* in August 1747 promoting a course of philosophical lectures in Birmingham.<sup>839</sup> On 24<sup>th</sup> May 1748 in *The Gloucester Journal*, he invited interested parties in the Severn-side towns, including Bridgnorth and Ludlow, to participate in courses of six lectures, intended to have precipitated a trip by Martin through Shrewsbury to Chester.<sup>840</sup> The circulation of *Aris's Gazette* covered Shropshire and its earliest published example of an invitation to attend philosophical lectures in the county appeared on 18<sup>th</sup> July 1748 on behalf of Francis Midon.<sup>841</sup> His course of nine lectures at Shrewsbury cost 1s 6d per lecture and was repeated two months later at Oswestry.<sup>842</sup> Locally published newspapers commenced later in the eighteenth-century, *The Shrewsbury Chronicle* first being published in 1772 and *The Salopian Journal* in 1794. Individual advertisements by lecturers have been identified in those journals but an extensive study has still to be undertaken to establish a more complete understanding of their activities within the area. John Banks, for example, solicited 'the patronage and attention of the ladies and gentlemen of Shrewsbury and its environs, to a course of twelve lectures in the most useful parts of Experimental Philosophy; elucidated and confirmed by many experiments.'<sup>843</sup> In a previous study of the itinerant lecturers' activities within the west midlands in the latter half of the eighteenth-century, some eighteen lecturers associated with natural philosophy were identified by means of advertisements placed in *Aris's Gazette* between 1742 and 1792.<sup>844</sup> How many of these lecturers found their way to Shropshire is not clear. Other sources place John Arden of Derby

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<sup>838</sup> Millburn, J., *Benjamin Martin: author, instrument-maker, and country showman* (Leyden, 1976), p.49.

<sup>839</sup> Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009), p. 73; *Aris's Birmingham Gazette*, 10<sup>th</sup> & 17<sup>th</sup> August 1747.

<sup>840</sup> Millburn, J., *Benjamin Martin: author, instrument-maker, and country showman* (Leyden, 1976), p.49.

<sup>841</sup> *Aris's Birmingham Gazette*, 18<sup>th</sup> July 1748.

<sup>842</sup> *Aris's Birmingham Gazette*, 19<sup>th</sup> September 1748.

<sup>843</sup> University of Birmingham Cadbury Research Library, Ref: - Collection of newspaper cuttings collected by Corbett family 1753-1887, *The Salopian Journal*, 25<sup>th</sup> January 1797, 15<sup>th</sup> February 1797, 22<sup>nd</sup> February 1797.

<sup>844</sup> Bruton, R. N., *An examination of the extent to which scientific lecturers were contributing to the dissemination of knowledge in the mid-eighteenth-century West Midlands* (2009), unpublished MA dissertation (University of Birmingham, 2009).

in Shrewsbury in 1763 and John Cash of Coventry at Coalbrookdale in 1779.<sup>845</sup> A bill for attendance at a John Warltire (nd-1810) lecture in September 1791 exists amongst the school bills of the sons of Mr Geoffrey Payne.<sup>846</sup>

Reliance upon advertisements for a clear picture of the localised activities of the lecturers understates the extent of their presence given that some courses are known to have been promoted privately or by personal sponsorship; for example, John Warltire's course commencing 21 February 1779 at Etruria was promoted by Josiah Wedgwood;<sup>847</sup> and the industrialist John Roebuck made representations to both James Watt and to Matthew Boulton to secure subscriptions for a course of lectures by Henry Moyes.<sup>848</sup> Others would have been publicised by notices posted within the coffee houses and clubs that flourished contemporaneously (see Image 6/1).<sup>849</sup> Following a successful course, lecturers frequently remained within the general locality to satisfy the demand arising from public enthusiasm. On 15<sup>th</sup> July 1771 James Ferguson (1710-1776) advertised for subscribers to a fifth course of lectures to be held in Birmingham, the first, comprising twelve lectures, having been promoted on 27<sup>th</sup> May.<sup>850</sup> Martin had earlier encapsulated the growing public mood for the acquisition of scientific knowledge and self-improvement: 'Knowledge is now become a fashionable thing and philosophy is the science 'a la mode.'<sup>851</sup> Lecturing continued into the nineteenth-century although from the end of the first quarter there was an increasing incidence of delivery through the auspices of Mechanics' Institutions and similar organisations, in such

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<sup>845</sup> Money, J., *Experience and identity: Birmingham and the West Midlands, 1760-1800* (Manchester, 1977), p. 151; Trinder, B., *The Industrial Revolution in Shropshire* (London, 2000), p. 106.

<sup>846</sup> Shropshire Archives, Ref: 3693/4/5, 'Mr Geoffrey Payne of South Africa, School Bills- Xmas 1791, Master Edward and Master James attending Mr Warltire's lecture.'

<sup>847</sup> Josiah Wedgwood to J. Warltire, 5<sup>th</sup> February 1779, and Wedgwood to Thomas Bentley, 25<sup>th</sup> February, 1779, cited in McKie, D., 'Mr Warltire, a good chymist,' *Endeavour*, Vol. 10, no. 37, January 1951. It was during the progress of this course that a young Robert Waring Darwin and Wedgwood's son John, received daily tuition from Warltire on natural philosophy.

<sup>848</sup> 'Roebuck to Watt, J.,' 1st January 1777; 'Roebuck to Boulton, M., 3<sup>rd</sup> October 1777,' cited in Musson, A. E., and Robinson, E., *Science and Technology in the Industrial Revolution*, (Manchester, 1969).

<sup>849</sup> Image: 6/1. This rare surviving example of an advertising bill dates from 1835 and features the demonstration at the Lion Hotel, Shrewsbury of an orrery or planetarium. The lecturer, Mr Franklin is possibly Deane Franklin Walker (1778-1865), the son of the renowned writer and lecturer Adam Walker (1730-1821), who continued to demonstrate the Eiduranion after his father's death in 1821. Shropshire Archives, Ref: 665/4/203, Eyton Collection, Lecture bill Mr Franklin.

<sup>850</sup> *Aris's Birmingham Gazette*, 27<sup>th</sup> May 1771, 10<sup>th</sup> June 1771, 17<sup>th</sup> June 1771, 8<sup>th</sup> July 1771, 15<sup>th</sup> July 1771.

<sup>851</sup> Martin, B., *A course of lectures in natural and experimental philosophy* (London, 1743), preface.

locations as they existed. Minutes of the Shropshire Mechanics' Institution give details of courses provided for members; in July 1827, for example, John Murray was recruited to give a series of lectures on chemistry at a cost of 2s 6d each or 10s 6d for the course.<sup>852</sup>

Image: 6/1

**PATRONIZED BY**

The Most Noble the Marquis of Bute; The Most Noble the Marquis of Hastings; The Right Hon. the Earl of Dartmouth; The Right Hon. the Earl Fitzwilliam; The Right Hon. the Earl of Mountnorris; The Right Honourable Lord Hastington; Sir R. B. P. Phillips, Bart.; Sir J. Owen, Bart.; Rev. Dr. Llewellyn, Rev. A. Olivant, St. David's College, Lampeter; Rev. G. A. Evers, William Lutener, Esq., Newtown; Rev. William Clive, D. Pugh, Esq.; and Robinson Jones, Esq., Welsh Pool; Rev. R. W. Kyle, Rev. C. R. Cameron, and John Horton, Esq., Wrockwardine Wood; Edward Monckton, Esq., Brewdow; &c.

*The Power and Wisdom of God in the Works of Creation,*  
DISPLAYED IN  
**TWO ASTRONOMICAL LECTURES,**  
ON THE EIDOURANION,  
*Or Grand Transparent Orrery,*  
FORTY FEET IN CIRCUMFERENCE,  
In the ASSEMBLY-ROOM, LION HOTEL, Shrewsbury,  
On Monday and Tuesday, September 21 and 22, 1835.

MR. FRANKLIN very respectfully and gratefully acknowledges the liberal Patronage and kind Reception he received in Shrewsbury on a former Occasion, (in 1827), when, through the aid of several distinguished and improved his Apparatus, and indulges the sanguine hope, that the Lectures he has now the honour to present will, from his additional Experience, be found to merit the Approbation of an enlightened Public. All the most interesting Subjects of Mr. F.'s former Course of Three Lectures will be introduced; and also two new additional Scenes, now in a state of preparation, one of which will represent the Orbit of the present Comet, showing in what Constellation it has already appeared, and through which it has yet to pass.



**LECTURE I.**

**INTRODUCTION.**—Astronomical knowledge calculated to give man a proper conception of the powers of his own mind. The apparent errors of various points out, showing that the Works of Nature are far more extensive and magnificent than we can possibly conceive. The Earth proved to be a spherical body.

**SCENE I.**—Will exhibit the Moon in various parts of her Orbit, showing the Phases presented to the Earth during her Revolution. Telescopic views of the Moon, as seen in the Full, the Quadratures, and in every other part of her Orbit. Also, several interesting Scenaria of the Moon, as seen to the most improved Earth.

**SCENE II.**—Will present Eclipses of the Sun and Moon, particularly that of the Sun in 1829. The Moon will be seen passing the Umbra and Penumbra of the Earth, and its inclination to the Ecliptic. The Moon, also, will be seen reflecting her borrowed light upon the Earth; and it will be demonstrated that the Earth reflects its light on the Moon, acting as a "lunar light to rule her nights," as that luminary does with regard to our Earth.

**SCENE III.**—On a Grand TELLURIAN will be seen the Earth passing by the Sign of the Zodiac, demonstrating, in its annual course, the beautiful vicissitude and its inclination to the Ecliptic. The apparent motion of the Heavens proved to be occasioned by the motion of the Earth. The Parallelism of the Earth's Axis, Orbit, accompanied by the Moon, showing the Changes, Librations, Latitudes, Longitudes, mean and true Anomaly, Apsees, Nodes, &c. of that Satellite, and when Eclipses of the Sun and Moon take place; by which these phenomena will be rendered familiar to the capacities of children.

**SCENE IV.**—The GRAND ORRERY. This Machine moves twelve feet high, and will present a brilliant view of the PLANETS, accompanied by their respective Satellites, bearing their marks visible on their disks, viz. the Ring of Saturn, the Balls of Jupiter, &c. At one view is exhibited a novel and interesting scene—all the Planets moving in majestic order, and performing their periodical revolutions round their glorious centre, the Sun. By this Apparatus will be seen the Heliocentric and Geocentric Places of the Planets, which will enable youth to understand the Epiphemera.

**LECTURE II.**

**INTRODUCTION.**—The study of Astronomy calculated to confirm the belief of man in Divine Revelation. The Sun, Moon, and Planets proved to be spherical bodies. The motion, position, and elements of COMETS, more particularly those of 1680, 1811, 1832, 1835, 2222, and the possibility of their destroying the Earth infested; the probable cause of their Tails, and the method of taking their position, and tracing their path in the Heavens by means of a Quadrant.

**SCENE I.**—The figure of the Earth and its atmosphere represented by a Globe six feet diameter. By which it will be proved that the Earth is truly spheroidal from its centre to every part of its surface. Gravitation and Attraction. Winds, Tides, Currents, &c.

**SCENE II.**—Will present a scene founded on the supposition of a plurality of Worlds, exhibiting every Star as a Sun, surrounded by a system of Planets; "The Worlds were framed in the Word of God." Heb. xi. 3. The Moral account of the Creation proved to be consistent with itself and with philosophical truth. The Sun proved to be an opaque body, and the Moon accounted for.

**SCENE III.**—The Orbits, Elements, and Appearance of Comets in general, but more particularly of that now visible, and of those of 1680, 1811, 1832, and 1835.

**SCENE IV.**—The Earth, with a Vessel sailing round it. An Eclipse of the Moon. The erroneous Systems of Tycho Brahe and Ptolemy. The Galaxy. The Scattered Systems of Orom and Ura Major, and other auxiliary Diagrams.

**SCENE V.**—To conclude with the GRAND ORRERY.

Admission to each Lecture, Front Seats 2s; Children 1s; Back Seats 1s.—No Admittance allowed behind the Scenes.

Doors to be opened at Half past Six; the Lectures to commence at Seven o'Clock.

Tickets to be had of Mr. EDDOWE, Mr. EDGERLEY, and Mr. TIBNAM, Booksellers, and of Mr. FRANKLIN, at Mr. Hills's, Pricks Hill.

EDGERLEY, PRINTER, SHREWSBURY.

Franklin's Eiduraneon Lecture with permission of Shropshire Archives

<sup>852</sup> Shropshire Archives, Ref: 6001/120, Minutes of the proceedings of the Shrewsbury Mechanics Institution

In keeping with the social and cultural ethos of the period, the lecturers participated in forums of knowledge exchange. In doing so they furthered the dissemination of knowledge and enhanced their credibility as teachers by being responsive to new discoveries and to the wishes of their audiences in respect of the content of their courses. An extended visit to Birmingham between December 1789 and April 1790 saw Warltire vary the subject matter within his lectures during his stay: courses on optical instruments and mechanics; airs, electricity and agricultural substances; astronomy; fluids, airs, astronomy and electricity; lights, colours and magnification were packaged offerings to the ambitious and inquisitive (see Image 6/2). Undeniably the most reactive of itinerant lecturers traversing the region, Warltire would also have been aware of the financial benefits to be wrought from keeping his course content fresh. The most visible examples of their intellectual networks were those involving industrialists and philosophers. Warltire conducted experiments with and on behalf of Joseph Priestley and fellow members of the Lunar Society; as did Adam Walker (1730-1821); Ferguson was a confidant of the painter Joseph Wright, Erasmus Darwin, and the Derby philosophers as well as being acquainted with Matthew Boulton.<sup>853</sup> A letter from Warltire to Priestley on 18<sup>th</sup> April 1781 concerning ‘the firing of airs,’ underlines the scientific rigour that Warltire applied to scientific experimentation (Appendix 6/1).<sup>854</sup> In 1782 he was amongst the first group of honorary members elected to the Manchester Literary and Philosophical Society, it being recognition for those who had distinguished themselves in the fields of interest pursued by the society.<sup>855</sup> But whatever knowledge and proficiency they possessed in experimental philosophy there was great skill employed in presentation of science fact and method in an understandable form. Some proclaimed their artistry in their promotional material and publications, James Ferguson declaring his intention “to make the

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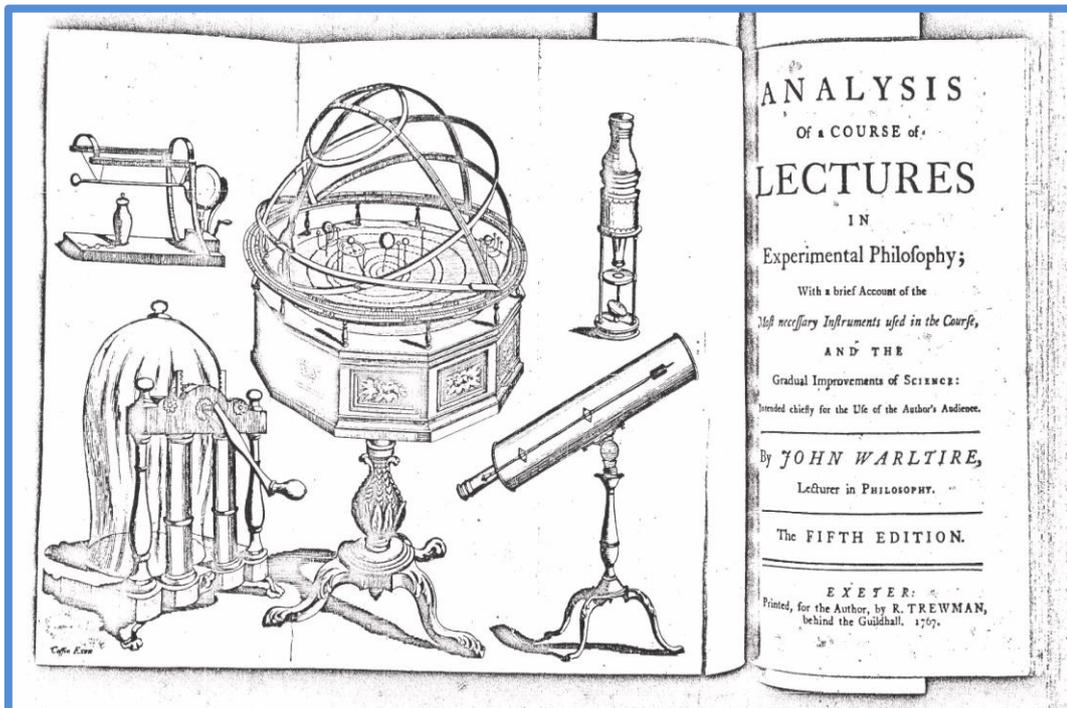
<sup>853</sup> Lound, A. P. B., *Lunatick Astronomy: the astronomical activities of the Lunar Society* (Birmingham, 2008), pp. 22-3, 62-3.

<sup>854</sup> Priestley, J., *Experiments and observations relating to the various branches of natural philosophy*, Vol. 2 (Birmingham, 1781).

<sup>855</sup> Mc Kie, D., ‘Mr Warltire, a good chymist,’ *Endeavour*, Vol. 10, No. 37, January 1951; Torrens, H. S., ‘Warltire, John (1725/6–1810)’, *Oxford Dictionary of National Biography*, Online edn. 2006, <http://www.oxforddnb.com/view/article/38107>.

various branches of physical science accessible to those who are not accustomed to mathematical investigation.<sup>856</sup>

Image 6/2:



John Warltire *Analysis of a course of lectures*, permission of Cadbury Research Library

The role of philosophical lectures in the transmission of knowledge and the advancement of cultural enlightenment has been questioned by some, the determination being that they more realistically represented a source of entertainment.<sup>857</sup> Heilbron contends that a contemporary lack of alternative forms of amusement prevailed up until the mid-eighteenth-century that rendered scientific lectures attractive to those looking for pastimes.<sup>858</sup> Certainly in the middle of the century some lecturers were promoting the ‘amusements’ and ‘entertainments’ of their courses in published advertisements.<sup>859</sup> Within twenty years, however, that had changed.

<sup>856</sup> Ferguson, James, (Brewster, David (ed.)), *Ferguson's lectures on select subjects of mechanics, hydrostatics, hydraulics, pneumatics, optics, geography, astronomy and dialling* (Edinburgh, 1806, 2<sup>nd</sup> ed.).

<sup>857</sup> Jacob, M. C., and Stewart, L., *Practical matter: Newton's science in the service of industry and Empire, 1687-1851* (Cambridge, 2004), Stewart, L., *The rise of public science: rhetoric, technology and natural philosophy in Newtonian Britain, 1660-1750* (Cambridge, 1992), p. 128.

<sup>858</sup> Heilbron, J. L., *Electricity in the seventeenth and eighteenth centuries* (New York, 1999) p. 162.

<sup>859</sup> *Aris's Gazette*, 29<sup>th</sup> December 1747, 5<sup>th</sup> December 1747, 12<sup>th</sup> December 1747.

Arden, for example, now expounded upon the breadth of the course and the modernity of his equipment instead of drawing attention to its entertainment value.<sup>860</sup> He expressed the accessibility of his course to those not experienced in the relevant fields of study. Pitt appealed to the ‘lovers and encouragers of science’ and Warltire emphasised the content’s direct interest to the ‘manufacturers of the Country’ and the scope offered for their improvement.<sup>861</sup> ‘Such entreaties are largely appeals to ambition; to the socially or culturally ambitious or to those who in other respects seek improvement and as such mark the distinction between serious instruction and amusements.’<sup>862</sup>

Published course material and advertisements for lectures offer an insight into their structure and content, however, the style of delivery of course content and its visual appeal is lost in the narrative form. It is therefore difficult to determine the nature of any ‘spectacular’ content aimed at those attracted to amusements as much as to knowledge (Appendices 6/2-4.

Considerations must however be given to the freshness of the science and ideas transmitted and in such circumstances even the most uninspired exposition may have provoked astonishment.<sup>863</sup> From a modern perspective it is also hard to envisage the maintenance of a state of amused distraction or wonder for the duration of twelve or twenty-four lectures.

Consequently one may speculate that showmanship was designed not only to draw the public but to refresh appetites for the serious nature of the on-going content.<sup>864</sup> That said, a series of eight lectures on chemistry by Thomas Dugard at Shropshire Infirmary left Katherine Plymley sufficiently unmoved by any spectacle to limit comment to the ‘neatness’ of presentation, suggesting that ‘spectacle’ was not ubiquitous, at least by 1804. Her background of lifelong

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<sup>860</sup> *Aris's Gazette*, 2<sup>nd</sup> September 1765.

<sup>861</sup> *Aris's Gazette*, 3<sup>rd</sup> August 1778 and 20<sup>th</sup> March 1780.

<sup>862</sup> Bruton, R. N., *An examination of the extent to which scientific lecturers were contributing to the dissemination of knowledge in the mid-eighteenth-century West Midlands* (2009), unpublished MA dissertation (University of Birmingham, 2009), p. 34.

<sup>863</sup> Bruton, R. N., *An examination of the extent to which scientific lecturers were contributing to the dissemination of knowledge in the mid-eighteenth-century West Midlands* (2009), unpublished MA dissertation (University of Birmingham, 2009), p. 36.

<sup>864</sup> Bruton, R. N., *An examination of the extent to which scientific lecturers were contributing to the dissemination of knowledge in the mid-eighteenth-century West Midlands* (2009), unpublished MA dissertation (University of Birmingham, 2009).

self-improvement suggests a particular interest in the educational value of the course content than entertainment or fashionable prescription. With an interest in natural history, particularly entomology, she painted and read extensively and her reaction to Dugard's course is that of a serious student.<sup>865</sup>

Image: 6/3



Adam Walker at English Opera House exhibiting Eiduraneon 21st March 1817 by Edward Burney (1760-1848), permission of the National Portrait Gallery.

<sup>865</sup> Shropshire Archives, Ref: 1066/ 62, Corbett of Longnor Collection, 'Katherine Plymley's Journals', 4<sup>th</sup> May 1804.

Something that regularly drew attention because of their appeal to the senses were Walker's astronomy lectures incorporating his Eiduranion orrery. He presented to a full house at the Theatre Royal, Haymarket in 1778-9 and in Sheffield attendances in 1806 were reportedly around 800 per evening with an entrance fee at 1/- per head (see Image 6/3).<sup>866</sup> But the promotion of his 1781 demonstration of the Eiduranion in Birmingham offers the prospect of a suitably educational divertissement, suggesting that publicising entertainment value was not believed to compromise the integrity of the serious content, for those who wished to engage in the acquisition of knowledge (see Appendix 6/4).<sup>867</sup> The criteria brought to lectures by individual audience members seem therefore to define the particular benefits to be taken from such programmes rather than any prescriptive presumption of response to visual and emotional stimuli: in general terms, accession to useful knowledge, a divertissement, serving a cultural or economic need or a combination of all these. In a practical sense lectures also provided visible embodiment of experiments and equipment that may not be adequately portrayed by textual references. The identification of those attending philosophical lectures consequently becomes important in determining the direction of regional cultural enlightenment.

In addition to a diversity of motivations precipitating attendance at lectures, cost constraints have been claimed by historians to have determined audience constitution, in particular that courses were frequently rendered beyond the affordability of artisans and tradesmen. But in arriving at such a conclusion due consideration has to be afforded to local economic and social circumstances including earning levels. From the mid-eighteenth-century the major industrial towns were displaying a vibrancy wrought of innovation and the pursuit of

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<sup>866</sup> *Cheshire Notes and Queries*, Vol. 1 (1896), pp. 190-192; Carlyle, E.I., rev. Jones, M. G. M., 'Walker, Adam (1730/1-1821),' *Oxford dictionary of national biography*, 2004; Inkster, I., 'The development of a scientific community in Sheffield, 1790-1850,' in *Scientific Culture and Urbanisation in Industrialising Britain* (Aldershot, 1997 originally 1973), pp99-131, p. 101.

<sup>867</sup> Bruton, R. N., *An examination of the extent to which scientific lecturers were contributing to the dissemination of knowledge in the mid-eighteenth-century West Midlands* (2009), unpublished MA dissertation (University of Birmingham, 2009), p. 35.

improvement: in economic terms pay levels reflected the skills of the artisanal strata of local society. The agriculturalist, Arthur Young discovered on a visit in 1791 that some of the workers in Birmingham were earning as much as £3 per week, with button trade workers averaging between 25s and 30s per week.<sup>868</sup> On the Shropshire Coalfield in comparison the demands of the particular working environments and the high skill levels needed in the iron works were also reflected in enhanced wage rates.<sup>869</sup> In 1793 Plymley recorded that some skilled workers in the Coalfield area earned up to £2 per week, significantly above payments made in agricultural parishes. Colliers and lower grade furnace workers in 1817 were paid around 15s per week.<sup>870</sup> Throughout the period therefore, there remained a differential between the Coalfield and the high-wage, highly skilled economies of industrial towns like Birmingham. The extent to which earnings were decisive in determination of the ability of craftsmen and artisans to attend self-improving lectures remains subjective due to the shortage of extant contemporary records on the subject for Shropshire.

In the second half of the eighteenth-century the prices charged by lecturers were widely standardised, a course of eight or twelve lectures costing one guinea and for a greater number, up to thirty lectures, two guineas. It equated to between 1s 4d and 2s 6d for each lecture. In 1779 John Warltire offered a course of thirty lectures on chemistry for two guineas, ladies and boys being invited to subscribe at half price.<sup>871</sup> Where offered, individual lectures within a course of twelve, costing one guinea, were frequently priced at 2s 6d.<sup>872</sup> In the period up to 1780s, however, advertisements routinely quoted fees for subscription to the full course only, lecturers seeking to fill the capacity that way rather than by ticket sales for each lecture.

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<sup>868</sup> Pugh, R. B., (ed.) *Victoria County Histories of Britain: a history of the county of Warwick*, vol. 7 (London, 1965), p.109.

<sup>869</sup> Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p.160.

<sup>870</sup> 'Gilbert Gilpin to J. J. Guest, 12th October 1817,' Cited in Trinder, B., *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), p.160.

<sup>871</sup> *Aris's Gazette*, 11<sup>th</sup> October 1779, Mr Warltire's lecture.

<sup>872</sup> *Aris's Gazette*, 10<sup>th</sup> June 1782, Mr Warltire's lecture; *Salopian Journal*, 15<sup>th</sup> February 1797, 'An extensive course of lectures in experimental philosophy...by J. Banks.

Undoubtedly the affordability of two guineas, or in many cases even one, would be a challenge to many ambitious craftsmen or artisans earning two pounds per week or less but as John Kennedy, the Manchester cotton-spinner demonstrated, the sharing of entrance fees made attendance affordable.<sup>873</sup> However not all lectures and courses in the period demanded subscription. Francis Midon's first documented visit to Shrewsbury in July 1748 promoted his 'Philosophical Lectures' at a price of 1s 6d per lecture, with 'no subscription required.' Within two years from his earlier quoted course, Warltire's lectures were being offered with single lecture options in addition to subscriptions. His course in March 1781 in Birmingham was priced at one guinea for gentlemen, half a guinea for ladies and two shillings for individual lectures.<sup>874</sup> Certainly costs of between 1s 6d and 2s 6d would not render such lectures the exclusive preserve of the gentry and industrialists in the eighteenth-century and to the enthusiastic, like John Kennedy, would not have been an impediment to attendance. Evidence of encouragement for artisans to attend is found in the publications and course literature of lecturers. Warltire's *Concise essays* are targeted 'at artisans and philosophers in the hope that notes and accompanying experiments and courses will lead to improvements in the application of those branches of chemistry.'<sup>875</sup>

From the second quarter of the nineteenth-century science-based lectures were widely organised through the Mechanics' Institutes and subject-specific societies established within the county.<sup>876</sup> The minutes detailing the lectures conducted at the Shropshire institute are spasmodic and give little continuing record of self-improvement courses conducted on behalf of its members, other than an occasional note of the lecturers' names and the cost of their courses. John Murray is mentioned on three occasions talking on various subjects including

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<sup>873</sup> Kennedy, J., *Miscellaneous Papers* (Manchester, 1849), p. 14, cited in Musson, A. E., and Robinson, E. *Science and technology in the Industrial Revolution* (Manchester, 1969), p. 108. See below for details of Kennedy's experience.

<sup>874</sup> *Aris's Gazette*, 12<sup>th</sup> March 1781, Mr Warltire's lecture.

<sup>875</sup> University of Birmingham Cadbury Library, Ref: Wigan AC911-125, Warltire, J., *Concise essays upon various philosophical and chemical subjects proper to be read before or after courses of Chemistry, or experimental philosophy*.

<sup>876</sup> Inkster, I., *Scientific Culture and Urbanisation in Industrialising Britain* (Aldershot, 1997), p.90.

chemistry; talks offered by others included several more on chemistry, natural history and astronomy. Extant records present little information on the number of individuals that were frequenting the institute's courses. By contrast the earliest programmes of lectures at the Derby Mechanics' Institute witnessed attendances between 200 and 600 people and numbers occasionally rose to 800.<sup>877</sup> The Derby institute was imaginatively organised and whilst variations in the organisation and functioning were identifiable amongst different Mechanics' Institutes, no evidence has been forthcoming suggesting that the Shropshire institute was considered deficient by members in its provision of resources for self improvement.

Whether philosophical lectures were attended by the individual for reasons of amusement, fashionable dictat or in furtherance of the cause of improvement or enlightenment ideals is difficult to ascertain, in many instances a combination of those factors would apply; nevertheless members of the Shropshire social elite presented themselves at those events. At Midon's course of nine lectures at Oswestry in 1748 John Mytton of Halston and Sir Watkin Williams Wynn of Wynnstay were amongst the audience. At Dugard's lectures in Shrewsbury, Plymley counted approximately seventy persons in the audience including Robert Waring Darwin.<sup>878</sup> The presence of women at lectures offers further evidence of the cultural role of the itinerant lectures in association with the developing status of women in the public sphere and is addressed in the case study below. In such an environment the lecturers were frequently promoting their courses to women not only for opportunity to further the dissemination of knowledge, but being ever mindful of the commercial potential of an expanding market. Advertisements would appeal to 'the gentlemen and ladies' of the town and price differentials between men and women were maintained to encourage women to

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<sup>877</sup> Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850* (Manchester, 2009), p. 245.

<sup>878</sup> *Aris's Gazette*, 19<sup>th</sup> September 1748; Shropshire Archives, Ref: 1066/ 62, Corbett of Longnor Collection, 'Katherine Plymley's Journals', 4<sup>th</sup> May 1804.

participate.<sup>879</sup> In 1797 John Banks sought ‘the patronage and attention of the ladies and gentlemen of Shrewsbury and its environs,’ whilst Francis Midon submitted to the ‘desires of several ladies,’ in undertaking a separate course for women.<sup>880</sup> It is a sign of cultural change, in part due to the contributions of the itinerant science lecturers, that by the end of the eighteenth-century women participated in philosophical study and engaged in writing upon science subjects.<sup>881</sup> The doors to science, however, were not thrown wide open and women continued to struggle to assert their rights to participate in the wider public sphere through the first half of the nineteenth century in particular.<sup>882</sup> In Shropshire, the Plymley sisters and Louisa Charlotte Kenyon epitomised the adoption of science by women in a contemporary domestic environment and the influence they bore upon the cultural development of the young people in their charge.<sup>883</sup>

The desire by progressive parents to give their children access to science instruction has been illustrated with reference to private tuition obtained from itinerant lecturers and it is also identifiable through their attendance at public lectures.<sup>884</sup> John Gilbert, steward to the Duke of Bridgewater, accepted Matthew Boulton’s offer to escort Gilbert’s son to a lecture by John Arden, commenting that he felt it so important to his education, ‘that I think it of the greatest consequence to attend.’<sup>885</sup> Mr Geoffrey Payne paid for the cost of his sons’ presence at a lecture by Warltire in Shrewsbury in 1791 and several of the Plymley children accompanied Katherine to Dugard’s course at the Infirmary.<sup>886</sup> Lecturers not only encouraged the

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<sup>879</sup> For example: *Aris’s Birmingham Gazette*, 2<sup>nd</sup> September, 1765; 12<sup>th</sup> March 1781..

<sup>880</sup> *Salopian Journal*, 25 Jan 1797; *Aris’s Birmingham Gazette*, 7<sup>th</sup> May 1744.

<sup>881</sup> Watts, R., *Women in science: a social and cultural history* (Abingdon, 2007), p. 97; Shropshire Archives, Ref: 1066/, Corbett of Longnor Collection, ‘Katherine Plymley’s Journals; Ref: 549/ 253-257, ‘Diaries of Louisa Charlotte Kenyon.

<sup>882</sup> Watts, R., *Women in science: a social and cultural history* (Abingdon, 2007), pp. 103-107.

<sup>883</sup> Shropshire Archives, Ref: 1066/, Corbett of Longnor Collection, ‘Katherine Plymley’s Journals; Ref: 549/ 253-257, ‘Diaries of Louisa Charlotte Kenyon; Watts, R., *Women in science: a social and cultural history* (Abingdon, 2007), p. 104.

<sup>884</sup> See pages 223 and 254 re tuition given to Robert Waring Darwin and Mary Kenyon, by John Warltire and John Murray

<sup>885</sup> Birmingham Archives and Heritage, Ref: MS3782/12/23/48-66, ‘Matthew Boulton papers,’ J. Gilbert to M. Boulton, 7<sup>th</sup> September 1765.

<sup>886</sup> Shropshire Archives, Ref: 3693/4/5- Xmas 1791, ‘Payne, Mr Geoffrey of South Africa, ‘Master Edward and Master James attending Mr Warltire’s lecture; Ref:1066/62, Corbett of Longnor Collection, ‘Katherine Plymley’s Journals’, 4<sup>th</sup> May 1804. Corbett of Longnor Collection, ‘Katherine Plymley’s Journals’, 4<sup>th</sup> May 1804.

attendance of children at lecture courses but in some instance wrote books specifically for them, which again reflect the influences of social and cultural change.<sup>887</sup>

Localised variability was reflected in the demographics of audiences for philosophical lectures and attempts to define them as the exclusive domain of educated social and industrial elites is inaccurate. This was particularly the case given the progressive influences of social and cultural change in the second half of the eighteenth and early nineteenth-centuries, as witnessed by the increasing visibility of female and artisanal activity. An earlier study by this author upon the subject suggests that attendance at lectures should not be considered as exclusively engagement at a social occasion or entertainment: a significant proportion of those present were participating with a purpose in mind, namely the pursuit to some degree of scientific knowledge.<sup>888</sup> The same point should be made with regard to the consumption of scientific literature or the acquisition of scientific ephemera. Fashionability and the impact of consumerisation cannot, however, be ignored given their conditioning influences upon contemporary cultural values but whatever an individual's motivation, for some they afforded an entree into the world of natural philosophy.<sup>889</sup>

### **6.3.2 The adoption of public science**

The growth in literature, particularly in the final quarter of the eighteenth-century, has been highlighted in previous chapters, specifically in the areas of technological change and agricultural improvement. The contribution of published material to the dissemination and assumption of knowledge in a non-utilitarian context was equally significant. By the 1750s books on natural philosophy were favoured reading for gentlemen, ladies and children and by

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<sup>887</sup> Ferguson, J., *An easy introduction to astronomy for young gentlemen and ladies* (London, 1790); Ferguson, James, *The young gentleman and lady's astronomy* (Dublin, 1792, 7<sup>th</sup> ed); Martin, Benjamin, *The young trigonometer's compleat guide* (London, 1736); Martin, Benjamin, *The young gentleman and lady's philosophy* (London, 1764).

<sup>888</sup> Bruton, R. N., *An examination of the extent to which scientific lecturers were contributing to the dissemination of knowledge in the mid-eighteenth-century West Midlands* (2009), unpublished MA dissertation (University of Birmingham, 2009), pp. 44-52.

<sup>889</sup> For example, McKendrick, N., Brewer, J., Plumb, J. H., *The birth of a consumer society: the commercialisation of eighteenth-century England* (London, 1982).

the final quarter of the century ranked amongst the most popular subjects.<sup>890</sup> Rousseau notes that library borrowing records also witnessed an increase in demand for books on science which placed their popularity on a par with literature and travelogues.<sup>891</sup> It is surprising therefore, that an Italian visitor to the west midlands in 1788 should comment on the lack of scientific publications in the booksellers of the region's largest town.<sup>892</sup> Birmingham in the late eighteenth-century was recognised as a centre for contemporary philosophical knowledge exchange and the range of organs of knowledge dissemination are identifiable, as documented elsewhere.<sup>893</sup> In such a context recommendation played an important role and undoubtedly influenced the acquisition of texts. In discussing additions to his own library with his son, Matthew Davidson suggests the young man should ensure he acquires a copy of Davy's 'Chemistry' and advises that he will forward a copy of Playfair's 'Huttonian Theory, from London when it is published.<sup>894</sup> Specialist books would frequently be sourced by a bookseller to order or were acquired by subscription; purchasers with connections in London often secured supply from the capital, as witnessed in the correspondence of James Watt.<sup>895</sup> Such circumstance suggests that the acquisition of scientific texts were therefore more the result of resolution than spontaneity and the stocking policy of booksellers less of a constraint on the dissemination of knowledge than might otherwise have seemed to be the case. The transposition of this scenario to the county towns of the region such as Shrewsbury and those of a lesser stature, offer the prospect of any constraints being dependent upon the

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<sup>890</sup> Rousseau, G. S., 'Science books and their readers in the Eighteenth Century,' in Rivers, I., *Books and their readers in Eighteenth -century England* (Leicester, 1982), p. 202.

<sup>891</sup> Rousseau, G. S., 'Science books and their readers in the Eighteenth Century,' in Rivers, I., *Books and their readers in Eighteenth -century England* (Leicester, 1982), p. 234.

<sup>892</sup> Jones, P. M., *Industrial Enlightenment: Science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2008), p. 72, citing *Relazionidi Marsilio Landriani sui progressi delle manufatturre in Europa alla fine dell Settocento a Cura di Mario Pessina. Introduzioni di Aldo de Maddalena* (Milan: Edizioni II Polifilo, 1981), p. 253.

<sup>893</sup> Jones, P. M., *Industrial Enlightenment: Science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2008), p. 73-82; Money, J., *Experience and identity: Birmingham and the West Midlands, 1760-1800* (Manchester, 1977).

<sup>894</sup> Ironbridge Gorge Museum Library, Mathew Davidson Correspondence, Copy letter book 1795-1818 (136 letters), Ref: DMD8- Acc No 1992.14918, Matthew Davidson to Thomas Davidson, 14<sup>th</sup> April 1812.

<sup>895</sup> Birmingham Archives and Heritage, Archive of Soho, Ref: MS3219/4/123/267, James Watt to James Keir, 22<sup>nd</sup> April 1786 and Ref: MS3219/4/123/273, James Watt to Jonathan Stokes, 15<sup>th</sup> June 1786.

opportunities for association than on the questionable availability of any material source of supply.

The county does not appear to have been short of book sellers, around 122 operating in Shropshire towns in the eighteenth and early part of the nineteenth-centuries, indicating that resource to printed material should not have been problematical even for those with little access to London sources.<sup>896</sup> Towns with recorded book sellers were: Shrewsbury, Ludlow, Bridgnorth, Oswestry, Wem, Madeley, Wellington, Bishop's Castle, Newport, Whitchurch, Market Drayton and Shifnal. Printers were thinner on the ground but no doubt numbers were driven by the level of demand. From 1760s there were three and sometimes four operating within Shrewsbury and one was identified in Ludlow in the 1770s. Newport, Oswestry, Whitchurch and Madeley had printers in the towns from around the 1790s.<sup>897</sup> For those with interest in specialist subjects the libraries attached to societies and associations afforded access to books and pamphlets. Shropshire Natural History Society established a library and museum which were to form the origins of their Shrewsbury public counterparts; as did the Ludlow Natural History Society.<sup>898</sup>

Printed material was widely accessible in coffee-houses and in some, libraries or book clubs functioned.<sup>899</sup> The utilisation of coffee houses for personal association and the exchange of knowledge was well-established in London from the middle of the seventeenth-century and provided the locations for discussion, debate and science lectures, throughout the following century and beyond (see Image 6/1).<sup>900</sup> An understanding of the functioning of the 'coffee-

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<sup>896</sup> Lloyd, L. C., 'The book trade in Shropshire; some account of the stationers, booksellers and printers at work in the county to about 1800,' *Transactions of the Shropshire Archaeological Society*, vol. XLVIII (48), 1935-6, pp. 65-200, p. 87.

<sup>897</sup> Lloyd, L. C., 'The book trade in Shropshire; some account of the stationers, booksellers and printers at work in the county to about 1800,' *Transactions of the Shropshire Archaeological Society*, vol. XLVIII (48), 1935-6, pp. 65-200, p. 87.

<sup>898</sup> Shropshire Archives, Ref: 6001/52/180, 'Shropshire and North Wales Natural History Society Minute Book (1835-1850); Ref: 6001/52/4981, Shropshire & North Wales Natural History Society Library catalogue; Ref: LB21/1, 'Ludlow Natural History Society Minute Book; Darwin Country, 'Leighton, Rev. William Allport. (1805-1889), <http://www.darwincountry.org/explore/000407.html>>

<sup>899</sup> For example Freeth's Coffee House in Birmingham, Money, J., *Experience and identity: Birmingham and the West Midlands, 1760-1800* (Manchester, 1977), p. 103.

<sup>900</sup> See Franklin's advertisement for a demonstration of his Eiduraneon at the Lion Hotel, Shrewsbury, Image: 6/1.

house culture' in Shropshire has not been established but McInnes notes that the first coffee houses appeared in Shrewsbury around 1680s.<sup>901</sup> John Macky's visit in the early 1720s found many of them: 'the most coffee houses around it that ever I saw in any town but when you come into them, they are but ale houses, only they think that the name of Coffee House gives a better Air.'<sup>902</sup>

The library of the Quaker industrialist, Abraham Darby III, epitomises the diversity of books owned by an eighteenth-century gentleman. It included histories, travel writing, classics and religious works and eighteen volumes on various elements of natural philosophy: chemistry, mineralogy, zoology, botany, 'Priestley on Airs' and 'Ferguson's Electricity' were represented. Rowland Hunt, a JP strongly associated with social welfare and civic improvement is not known as someone with scientific proclivities but his extensive book collection incorporates fifteen titles with a scientific theme. It is quite possible such books were acquired as a general interest in the contemporary state of knowledge on such matters, or in the context of a fashionable interest in science. Evidence has not been identified that confirms a greater interest on his part, in science. Such was the case with Robert Aglionby Slaney, MP for Shrewsbury. Extant diaries make references to his occupation with botany and birds when not on parliamentary business or engaged in social issues and include notes on a number of owned works of natural history, 'Sowerby's Botany,' 'Pennant's British Zoology' and 'Huber's work on bees' amongst them.

One of the social issues that occupied Slaney concerned the education of the poor, which he promoted in a treatise in 1824 and in the following year he became involved in the formation

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<sup>901</sup> McInnes, A., 'The emergence of a leisure town: Shrewsbury, 1660-1760, *Past and Present*, 120 (Aug 1988), pp. 53-87, p. 66.

<sup>902</sup> Macky, J., *A journey through England in familiar letters from a gentleman (sic) here to a friend abroad*, vol. II, p. 131

of the Shrewsbury Mechanics' Institution.<sup>903</sup> In his essay he quoted John Sumner: 'Of all obstacles to improvement, ignorance is the most formidable, because the only true secret of assisting the poor is to make them agents in bettering their own conditions; and to supply them, not with a temporary stimulus, but with a permanent energy.'<sup>904</sup> To Slaney the establishment of the Mechanics' Institution was a step in that direction.

### 6.3.3 Adult education

'The Mechanical Arts' were encompassed within 'natural philosophy' in the eighteenth and early nineteenth-century and their influence in the economic progress of the period has been examined above.<sup>905</sup> The creation of the Shrewsbury Mechanics' Institution was allied to the concept of self-improvement through cultural science. Established in 1825, it was amongst the earliest in Britain, the defined purpose of its formative subscribers being to create 'a Society to afford to Tradesmen, Mechanics, Artizans, and others, opportunities of acquiring at their leisure hours the principles of Science, and the Arts; and for the cultivation of Literature.'<sup>906</sup>

The principles espoused by such as George Birkbeck and Henry Brougham in the establishment of the London Mechanics' Institution (1823) were clearly influential.<sup>907</sup>

Brougham maintained that '...although the people must be the source and instruments of their own improvements, they may be essentially aided in their efforts to instruct themselves ...impediments may be removed...and efforts may, through judicious encouragement become effectual, and settle into a lasting and an universal habit.'<sup>908</sup> Inkster points out that the

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<sup>903</sup> Shropshire Archives, Ref: AS 63, Slaney, R. A., *An essay on the beneficial direction of rural expenditure* (London, 1824), p. 157; University of Birmingham Cadbury Library, Ref: RAS/1/3, 'The journals of R. A. Slaney, April 1825-January 1826,' 10<sup>th</sup> & 17<sup>th</sup> October 1825 and 16<sup>th</sup> November.

<sup>904</sup> Sumner, J. B., *A treatise on the records of the creation, and on the moral attributes of the creator; with particular reference to the Jewish history...*, Vol. II (London, 1818), p. 333.

<sup>905</sup> See Chapter 4

<sup>906</sup> Shropshire Archives, Ref: 6001/371/27, Miscellaneous documents re Shropshire Mechanics Institution, 'Rules of the Shropshire Mechanics Institution adopted at Special General Meeting on 24th September 1846.

<sup>907</sup> Shropshire Archives, Ref: 6001/120, Minutes of the proceedings of the Shrewsbury Mechanics Institution; Brougham, H., *Practical observations upon the education of the people addressed to working classes and their employers*, (London, 1825).

<sup>908</sup> Brougham, H., *Practical observations upon the education of the people addressed to working classes and their employers*, (London, 1825), p. 2.

presence of the itinerant lecturers within the regional towns, however, had established a background of knowledge dissemination that had rendered extension into the realm of instruction of the less fortunate elements of society, an appropriate and attainable development.<sup>909</sup> Local specificity therefore defined the nature of the structures and operation of these and similarly focussed organisations, such as the ‘Mutual Improvement Societies,’ ‘Literary and Scientific Institutions’ and ‘Athenaeums’ and affords the prospect of manifestations of ongoing enlightened ethos or expression of the notion of improvement.<sup>910</sup>

Although Brougham considered that the adoption of a disposition towards self-improvement was the responsibility of the individual, in Shropshire, as well as many other areas, the formation of the Mechanics’ Institution was embraced by progressive members of the local elite. A committee, initially of fifteen gentlemen, was formed to determine the rules governing the institution, four of whom were charged with seeking subscriptions from ‘the gentlemen in the Town and country.’<sup>911</sup> Donations were received totalling £235 from fifteen gentlemen including: Dr Robert Darwin; Dr Thomas DuGard; the architect and builder John Carline and his sons; Archdeacon Butler, former head of Shrewsbury School; R. A. Slaney; and the flax spinner John Marshall.<sup>912</sup> A schedule of sixty-eight ‘one-guinea subscribers,’ whose subscriptions entitled them to proprietary membership contains the names of seventeen identifiable gentlemen and several tradesmen, including grocers, ironmongers and printers.<sup>913</sup> The remainder require more extensive research than is afforded to this study but the influence of the gentlemen of the county in the early stages of Shropshire Mechanics’ Institution is substantial.

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<sup>909</sup> Inkster, I., ‘Science and the Mechanics’ Institutes, 1820-1850 : the case of Sheffield,’ in *Scientific Culture and Urbanisation in Industrialising Britain* (Aldershot, 1997).

<sup>910</sup> Kelly, T., *George Birkbeck: pioneer of adult education* (Liverpool, 1957), p. 212.

<sup>911</sup> Shropshire Archives, Ref: 6001/120, Minutes of the proceedings of the Shrewsbury Mechanics Institution.

<sup>912</sup> Shropshire Archives, Ref: 6001/120, Minutes of the proceedings of the Shrewsbury Mechanics Institution.

<sup>913</sup> Shropshire Archives, Ref: 6001/120, Minutes of the proceedings of the Shrewsbury Mechanics Institution.

The first order for books in October 1825 contained forty-nine volumes, with a mix of mechanics and scientific subjects. In comparison in 1838 the recorded list of book purchases was of a more generalised nature, including biographies and travel. The policies adopted in concerning lectures provided for members is difficult to establish, however, in the five months to May 1838 five of the seven lectures undertaken were of a scientific nature, namely: astronomy, electricity, electro-magnetism, optics and natural history. An inventory of laboratory equipment dating from the same period consisted of sixty-four items, many with multiple quantities attached and although no major equipment is identified it suggests a reasonably furnished facility for the location and the time. The extent to which it was utilised, however, is not apparent.

Membership numbers remained constant until 1834, before experiencing a stepped climb to a level in 1839 that was three times that of earlier in the decade. (see fig. 6/1) The impact of serious economic depression nationally between 1837 and 1842 probably accounted for falls of 27 percent in each of the years 1837 and 1840 but numbers remained healthily above those at the beginning of the 1830s.

**Fig. 6/1**

y/e 1/10/1828-	94 subscribers
y/e 1/10/1829-	81 "
y/e 1/10/1830-	78 "
y/e 1/10/1831-	91 "
y/e 1/10/1832-	91 "
y/e 1/10/1833-	91 "
y/e 1/10/1834-	82 "
y/e 1/10/1835-	?
y/e 1/10/1836-	148 "
y/e 1/10/1837-	108 "
y/e 1/10/1838-	160 "
y/e 1/10/1839-	291 "
y/e 1/10/1840-	210 "

**Shrewsbury Mechanics' Institution-  
Summary of Subscriber numbers:**  
 Extracted from the Shropshire Archives, Ref: 6001/120, Minutes of the proceedings of the Shrewsbury Mechanics Institution.

The composition of the membership is not known but it seems likely that its growth resulted largely from the increased activity in the pursuit of political and social reform as is witnessed elsewhere. Walker highlights the changes in membership structures within Yorkshire Institutes towards working class predominance.<sup>914</sup> The Bradford institute, for example, reported in 1838 that 300 of its 540 members came from the working classes:<sup>915</sup> as early as 1831 Manchester Mechanics' Institute had a large majority of working class members:<sup>916</sup> whereas in Sheffield in 1832 initial members of Sheffield Mechanics Institute were exclusively professionals, ministers of the church and industrialists.<sup>917</sup> Several earlier studies have considered the changes that were wrought to the programmes of dissemination of scientific knowledge, to the extent that science or the intellectual standard of lectures did not meet the needs of the current membership profile. This resulted in the introduction of topics considered to be more beneficial to members, in some instances serving basic educational needs.<sup>918</sup> The importance of consideration of local specificity is therefore self-evident in a study such as this one and more detailed research into Shropshire's Mechanics' Institutes than can be afforded here is required. A national increase in the number of societies and members had been experienced from 1832 and in the 1840s additional Mechanics' Institutions were operating in Oswestry, Ludlow, Ellesmere and Coalbrookdale.<sup>919</sup> Extant records from these societies, however, do not survive.

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<sup>914</sup> Walker, M., 'Encouragement of sound education amongst the industrial classes: mechanics institutes and working class membership 1838-1881, *Educational studies*, 2013, vol. 39 (2), pp. 142-155, p. 153.

<sup>915</sup> Walker, M., 'Solid and practical education within reach of the humblest means: the growth and development of the Yorkshire Union of Mechanics' Institutes 1838-1891,' unpublished PhD thesis, (University of Huddersfield, 2010), p.35.

<sup>916</sup> Tylecote, M., 'The Mechanics' Institutes in Lancashire and Yorkshire, 1824 – 1850, with special reference to the Institutions at Manchester, Ashton-under-Lyne and Huddersfield', unpublished PhD Thesis (University of Manchester, 1930), Vol. 1, Appendix 2, p.237, cited in Walker, M., 'Solid and practical education within reach of the humblest means: the growth and development of the Yorkshire Union of Mechanics' Institutes 1838-1891,' unpublished PhD thesis, (University of Huddersfield, 2010), p.35.

<sup>917</sup> Inkster, I., 'Science and the Mechanics' Institutes, 1820-1850,' in *Science culture and urbanisation in Industrialising Britain* Aldershot, 1997), p.

<sup>918</sup> For example Walker, M., 'Solid and practical education within reach of the humblest means: the growth and development of the Yorkshire Union of Mechanics' Institutes 1838-1891,' unpublished PhD thesis, (University of Huddersfield, 2010), p.35; Stockdale, C., 'Mechanics' Institutes in Northumberland and Durham, 1824-1902,' Unpublished PhD thesis, (University of Durham, 1993), p. 118.

<sup>919</sup> Kelly, T., *George Birkbeck: pioneer of adult education* (Liverpool, 1957), p. 230; Shropshire Archives, Ref: 6001/371/50 & 50a, 'Miscellaneous documents re Shropshire Mechanics Institution, Letters from Ellesmere Mechanics Institute..

The involvement of the middle and upper ranks of Shropshire society in the formation of the Mechanic's Institution was extensive but in places around the country it was an issue of some rancour.<sup>920</sup> Some historians of the subject also consider that the formation of Mechanics' Institutes were instigated, funded and their operational organisation largely determined by middle class patronage, often as a means of controlling the political ambitions of the lower ranks of society: at best they consider it serves as an example of patronage at its worst.<sup>921</sup> The debate over this issue has been well exercised in the past and will not be enjoined in this study other than to observe that on examination of local variability in this respect, the adoption of such a generalised position does disservice to those who saw a need in society that required addressing. R. A. Slaney and other progressive individuals pursued the amelioration of hardship and worked to advance the state of less-fortunate social groups and in attempting to improve the accessibility of knowledge to others may be seen to exercise an enlightenment spirit. Those craftsmen and artisans who attended lectures through the auspices of Mechanic's Institutes were themselves expressing a personal determination to improve.

#### **6.4 Geology and mineralogy**

In the period from mid-eighteenth to mid-nineteenth century, subject-specific scientific interests most widely pursued by Salopians included geology/mineralogy and natural history. In this and the following section, examination will be made of the contemporary enthusiasm for such matters displayed within the county. Katherine Plymley's journals once again provide a sense of the range of individuals engaged in study and practice of the subjects from amongst those people that she came into contact with.<sup>922</sup> The topography of the county

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<sup>920</sup> Engels, F., *The condition of the working classes in England in England in 1844* (1845, reprinted 1926)

<sup>921</sup> Walker, M., 'Encouragement of sound education amongst the industrial classes: mechanics institutes and working class membership 1838-1881', *Educational studies*, 2013, vol. 39 (2), pp. 142-155, p. 153; Roderick, G. W, and Stephens, M. D., *Scientific and technical education in the nineteenth-century* (London, 1978); Royle, E., 'Mechanics Institutes and the working classes 1840-1860,' *The Historical Journal*, Vol.14, 2, 1971.

<sup>922</sup> Shropshire Archives, Ref: 1066/, Corbett of Longnor Collection, 'Katherine Plymley's Journals.

undoubtedly led some residents to pursue a better understanding of their surroundings, galvanised no doubt by the Enlightenment sentiments of the time. For a number of enthusiasts, such as the ironmaster William Reynolds, there were added commercial implications associated with knowledge of the minerals and geological strata of the county: that being the potential for industrial exploitation of those minerals. It was a situation that had parallels in other areas endowed with landscapes inviting analytical study, such as those of Derbyshire and Elliott offers a comparative perspective.<sup>923</sup> Visitors with an interest in the subject enriched local knowledge, affirming the permeability of the artificial boundaries to knowledge and of the establishment of intellectual communities centred upon this field of endeavour. Geologists such as Prestwich, Aikin, Murchison and Sedgwick visited Shropshire with the furtherance of geological knowledge in mind.<sup>924</sup> However, as late as 1798 Robert Townson was drawn to comment that the mineralogy and geology of the country had been neglected, suggesting that there was little supportive patronage. Consequently, there had been little encouragement for study of the subject or coordination of knowledge gained.<sup>925</sup> Prior to the turn of the century geological study was centred upon the establishment of collections of minerals and fossils and it was the formation of the British Mineralogical Society in 1799 and the Geological Society in 1807 that brought more organisation into the science.<sup>926</sup> Townson's family were resident in Cardington, Shropshire from 1777 but until he established a base in the county in 1796, he was engaged elsewhere in serving an apprenticeship, studying and travelling throughout Europe.<sup>927</sup> Having been elected a fellow of the Royal Society of Edinburgh in 1791 and awarded a doctorate by the city's university in 1796, he returned to

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<sup>923</sup> Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850* (Manchester, 2009), pp. 142-5, 148-51.

<sup>924</sup> Trinder, B., *A history of Shropshire* (London, 1983, 2nd ed 1998) p. 16.

<sup>925</sup> Townson, R., *Philosophy of mineralogy* (London, 1798), p. vii.

<sup>926</sup> Torrens, H. S. *The practice of British Geology* (Aldershot, 2002), p. 115 & 118.

<sup>927</sup> Torrens, H. S., Townson, Robert (1762-1827), *Oxford Dictionary of National Biography*, 2004, [<http://www.oxforddnb.com/view/article/27639>]

Shropshire and undertook the writing of books.<sup>928</sup> During his residence in Shropshire Townson and the Plymley family became friends, Katherine recording his visits and the correspondence received from him and it was to them that he consigned his extensive collections of minerals, plants and insects on emigrating to Australia.<sup>929</sup> The generosity of spirit which afforded the sharing of philosophical knowledge epitomised Enlightenment ideals and it is evidenced in the Plymley diaries, not least in those relating to Townson's visits and correspondence and in the visits to him by such as Arthur Aikin (1773-1854).<sup>930</sup>

Briefly engaged as Unitarian minister in Shrewsbury (1793-5), Aikin had a progressive background, being the son of the doctor and writer John Aikin (1747-1822) and nephew to the educationalist Anna Barbauld.<sup>931</sup> His interest lay in science, however, Hugh Torrens indicating that it was stimulated by Joseph Priestley when Aikin studied at the Unitarian College at Hackney. Having undertaken several mineralogical tours and contributed as a writer or editor to a number of publications, he was a founding member of the Geological Society of London in 1807. In 1810 he published a prospectus seeking subscribers to a proposed mineralogical survey of Shropshire. Although the survey was eventually abandoned in 1816 through inadequate support, subscribers amongst the gentry, industrialists, clergy and medical practitioners within the county, provide evidence of the local level of interest in an emerging science. Charles Bage, Thomas Botfield, Joseph Plymley, Francis Darby, Thomas Dugard, Edward Harries, Rowland Hunt, Thomas N. Parker, Edward Earl Powis, John

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<sup>928</sup> Townson, R., *Philosophy of mineralogy* (London, 1798) and *Tracts and observations in natural history* (London, 1799) featured amongst his works, the second of which contained 'A sketch of the mineralogy of Shropshire,' which gave a detailed exposition of the geological topography of the county.

<sup>929</sup> For example, Shropshire Archives, Ref: 1066/68, Corbett of Longnor Collection, 'Katherine Plymley's Journals, 14<sup>th</sup> July 1806 to 31<sup>st</sup> October 1806.

<sup>930</sup> Torrens, H. S., 'Arthur Aikin's mineralogical survey of Shropshire 1796-1816 and the contemporary audience for geological publications,' pp.111-153, in *The practice of British Geology* (Aldershot, 2002).

<sup>931</sup> Torrens, H. S., Aikin, Arthur, *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [<http://www.oxforddnb.com/view/article/226>].

Stackhouse and the Marquis of Stafford were subscribers and all appear elsewhere within this study as exemplars of the contemporary expression of improving or enlightened behaviour.<sup>932</sup>

Another subscriber to Aikin's survey was William Anstice (1781-1850), who exhibited a passion for geology and mineralogy undoubtedly inspired by his father Robert and uncle, the ironmaster William Reynolds. Robert's own appetite for natural science was centred upon his home county of Somerset and it is quite possible that his geological interests had likewise been galvanised by Reynolds, whose enthusiasm was identifiable from an early age. On his tour of Shropshire in 1776 the secretary of the Society of Arts, Samuel More, made a diary entry describing 'young Mr Reynolds' collection of 'Ores and Minerals,' specimens from which were given to More and his companion Josiah Wedgwood. 'He also shewed us his Laboratory lately built for his trying experiments to which he is very attentive...'<sup>933</sup> Joshua Gilpin, the American Quaker, visited Reynolds in 1796, viewing his laboratory and 'large collection of fossils,' as in 1795 had the physician and professor of natural philosophy at the Royal Institution, Thomas Young (1773-1829).<sup>934</sup> Reynolds also contributed geological content to the published work of Plymley and Townson.<sup>935</sup> Reynolds' attitude to the dissemination of knowledge was centred on the premise that 'he had no secrets and wished there should be none where the success of humanity was affected' which accords both with Enlightenment sensibilities and the notion that creative networks functioned with few constraints, other than war.<sup>936</sup>

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<sup>932</sup> Torrens, H. S., 'Arthur Aikin's mineralogical survey of Shropshire 1796-1816 and the contemporary audience for geological publications,' pp.111-153, in *The practice of British Geology* (Aldershot, 2002), p. 144.

<sup>933</sup> Ironbridge Gorge Museum Library, *Transcription of Samuel More's Journal, 16<sup>th</sup> July 1776*, p. 4(original journal p. 16)

<sup>934</sup> Torrens, H. S., 'The Reynolds-Anstice Shropshire geological collection, 1776-1981,' *Archives of Natural History*, (1982), 10 (3): 429-441, p. 431; Trinder, B., 'William Reynolds: Polymath- A biographical strand through the Industrial Revolution,' in *Industrial Archaeological Review*, XXX:1, (2008), pp. 17-32, p. 27; Cantor, G., 'Young, Thomas (1773-1829), *Oxford Dictionary of National Biography*, 2004, <http://www.oxforddnb.com>.

<sup>935</sup> Plymley, J., *A General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1803); Townson, R., *Tracts and observations in natural history and physiology* (London, 1799).

<sup>936</sup> Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009), pp. 101-2.

Upon Reynolds' death in 1803 it was to his nephew William Anstice that his extensive collection of minerals and fossils passed. He had moved to Shropshire as assistant to his uncle around 1796 and following Reynolds' death also assumed management of one of the ironworks. Anstice was to add substantially to the collection, to the point of it becoming a 'reference collection' for other geologists.<sup>937</sup> William Buckland (1784-1856), Joseph Prestwich (1812-1896) and Roderick Murchison (1792-1871) all drew upon Anstice's knowledge of the geology of the county and in 1836 he became a Fellow of the Geological Society.

The Shropshire-born doctor Thomas Beddoes (1760-1808) was attracted to geology at Edinburgh University, where he was a contemporary of William Reynolds. His principle interest, in terms of his ambition for a medical career, was chemistry but on his return to Oxford in 1787, he lectured in both chemistry and geology.<sup>938</sup> He returned to Shropshire in 1791, staying with Reynolds at Bank House and having the use of the latter's laboratory.<sup>939</sup> The two men studied the effect of the furnaces upon minerals, with Reynolds encouraging Beddoes to write a paper on his observations for presentation to the Royal Society.<sup>940</sup> He also met Erasmus Darwin at this time and the two of them subsequently exchanged correspondence upon matters relating to geology.<sup>941</sup> Amongst others with a professed interest in the subject, the former curate Theophilus Houlbrooke was described by Joseph Reynolds as one who 'having taken up mineralogy with a warmth bordering upon enthusiasm has been a

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<sup>937</sup> Torrens, H. S., 'The Reynolds-Anstice Shropshire geological collection, 1776-1981,' *Archives of Natural History*, (1982), 10 (3): 429-441, p. 435.

<sup>938</sup> Neve, M., 'Beddoes, Thomas (1760-1808)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004, <http://www.oxforddnb.com/view/article/1919>.

<sup>939</sup> Jay, M. *The Atmosphere of Heaven: the unnatural experiments of Dr Beddoes and his sons of genius* (London, 2009), p. 46.

<sup>940</sup> Observations on the affinity between Basaltes and Granite, read at the Royal Society, 27<sup>th</sup> January 1791 cited in Jay, M. *The Atmosphere of Heaven: the unnatural experiments of Dr Beddoes and his sons of genius* (London, 2009), p. 19.

<sup>941</sup> Jay, M. *The Atmosphere of Heaven: the unnatural experiments of Dr Beddoes and his sons of genius* (London, 2009), p. 46.

long journey into the Highlands with Dr Hutton...'<sup>942</sup> Thomas DuGard pursued an interest in geology and mineralogy in addition to chemistry and Plymley notes being shown his mineral collection.<sup>943</sup> He is recorded as vice-president of the Natural History Society and joint curator of geology and also submitted papers for lectures to the members.<sup>944</sup>

## 6.5 Natural history and botany

'The Shropshire and North Wales Natural History Society' was formed in June 1835 with Samuel Butler as the president. It afforded opportunities for association within select communities: to confer upon issues of particular interest and to present the results of studies pursued. In the first year of existence membership of the Society reached 174 people, both men and women, eighty per cent of who arose from the professional or educated section of the population (Appendix 6/5). During the course of this study there has been a paucity of evidence unearthed of artisanal cultural scientific endeavour, although as Ann Secord recorded, botanical societies amongst artisans were being founded in homes from 1770s if not earlier.<sup>945</sup> In October 1833 a Natural History Society had been founded at Ludlow, its principal purpose being defined as the 'Establishment of a museum and library illustrative of the various departments of science for the use of members.'<sup>946</sup> There is no extant list of members but at the Annual General Meeting on 16<sup>th</sup> December 1836 the landed agricultural improvers, Viscount Clive, the Honourable R. H. Clive and Sir William Rouse-Boughton were notable by their presence. The fact that, in January 1845 a meeting of the society was

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<sup>942</sup> Cornwall Record Office, Ref: DD/DG41, Joseph Reynolds to Thomas Beddoes, 26<sup>th</sup> August 1791, cited in Torrens, H. S., 'The Reynolds-Anstice Shropshire geological collection, 1776-1981,' *Archives of Natural History*, (1982), 10 (3): 429-441, p. 430. Dr Hutton being James Hutton the geologist (1726-1797).

<sup>943</sup> Shropshire Archives, Ref: 1066/72, Corbett of Longnor Collection, 'Katherine Plymley's Journals, 27<sup>th</sup> Aug 1807 and 1066/60, 13<sup>th</sup> April 1802.

<sup>944</sup> Shropshire Archives, Ref: 6001/52/180, Shropshire & North Wales Natural History Society Minute Book (1835-1850), p. 14.

<sup>945</sup> Secord, A., 'Science in the pub: artisan botanists in early nineteenth century Lancashire' in *History of science*, 32:3=97 (Sept 1994) pp 269-315, p. 278.

<sup>946</sup> Shropshire Archives, Ref: LB 21/1- Ludlow Natural History Society- Minute Book.

summoned for its reconstitution may suggest that it had not been extensively supported in the more recent past.<sup>947</sup>

The diversity of interests accommodated by the Shropshire Natural History Society is reflected within its organisational structure, where curatorships in seven disciplines were established, namely: geology, mineralogy, ornithology, entomology, botany, antiquarianism and zoology.<sup>948</sup> The curator of ornithology was Thomas Campbell Eyton (1809-1880) who was to earn a notable reputation as an ornithologist, publishing several illustrated works and establishing an extensive museum on birds at his home, Eyton Hall.<sup>949</sup> A close friend of Charles Darwin, he corresponded with other naturalist historians and conveyed accumulated knowledge to the members of the Society through lectures and in his various published works.<sup>950</sup> The progressive MP Robert Aglionby Slaney was also elected a vice-president, his declared interest being botany, as was that of the Society's secretary William Allport Leighton (1805-1889). Leighton published the first Flora of Shropshire in 1841 and his subsequent works on lichens exceeded fifty books and papers between 1837 and 1879.<sup>951</sup>

Local expressions of interest in natural history also predate the founding of the Society. As a consequence of his inheritance, John Dovaston (1782-1854) was afforded the opportunity to pursue a passion for science, music, poetry and the classics and he maintained a correspondence and exchange of information with the artist Thomas Bewick (1753-1828).<sup>952</sup> He practised innovative studies of birds and whereas convention determined the shooting of birds for specimens, Dovaston used a glass to observe them; he set up nesting boxes and

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<sup>947</sup> Shropshire Archives, Ref: LB 21/1- Ludlow Natural History Society- Minute Book, p. 97.

<sup>948</sup> Shropshire Archives, Ref: 6001/52/180, Shropshire & North Wales Natural History Society Minute Book (1835-1850), p. 14.

<sup>949</sup> Thorne Fisher, C., 'Eyton, Thomas Campbell (1809-1880)', *Oxford Dictionary of National Biography*, 2004  
<http://www.oxforddnb.com/view/article/9046>.

<sup>950</sup> Thorne Fisher, C., 'Eyton, Thomas Campbell (1809-1880)', *Oxford Dictionary of National Biography*, 2004  
<http://www.oxforddnb.com/view/article/9046>; Shropshire Archives, Ref 6001/134, Volume of Letters relating to Shropshire and North Wales Natural History & Antiquarian Society, p. 105; Shropshire Archives, Ref: 6001/52/180, Shropshire & North Wales Natural History Society Minute Book (1835-1850), eg p.14.

<sup>951</sup> Jackson, B. D. 'Leighton, William Allport (1805-1889)', rev. D. J. Galloway, *Oxford Dictionary of National Biography*, 2004  
<http://www.oxforddnb.com/view/article/16406>.

<sup>952</sup> University of Birmingham Cadbury Library, Ref: MS737, 'The works of John Dovaston (1782-1854).'

artificially constructed nesting holes; and he undertook the capturing and ringing of migrant birds.<sup>953</sup>

The Ludlow doctor, Joseph Babington was an avid botanist and provided Joseph Plymley with details of the species of grass to be found in Shropshire for the 1803 Agricultural Survey.<sup>954</sup> He encouraged the love of botany within his son, Charles Cardale Babington, who in 1861 was to be appointed to John Henslow's position as professor of botany at Cambridge University, on the latter's death.<sup>955</sup> Reverend Archibald Alison, curate at Kenley and later at High Ercal, gained acclaim for his philosophical work, but pursued a fascination for natural history, in particular botany, ornithology and zoology.<sup>956</sup> The degree to which cultural sciences were adopted because of their fashionability is difficult to assess but there was a sense in some quarters that activities such as botany were a safe or genteel option, particularly for women.<sup>957</sup> The engagement of women in writing and studies in this area becomes more apparent by the end of the eighteenth-century and there are more visible representations both upon the domestic front and in the public sphere. It is appropriate, therefore, to examine a number of the individuals concerned and the contexts which conditioned their interest.

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<sup>953</sup> Allen, D. E., Dovaston, John Freeman Milward (1782-1854), *Oxford Dictionary of National Biography*, 2004, <http://www.oxforddnb.com/view/article/7946>.

<sup>954</sup> Ancestry.com, *Cambridge University Alumni, 1260-1900*, database online].

<sup>955</sup> Allen, D. E., 'Babington, (Charles) Cardale (1808-1895)', *Oxford Dictionary of National Biography*, 2004 [<http://www.oxforddnb.com/view/article/970>]

<sup>956</sup> Alison, A., *Essays on the nature and principles of taste* (London, 1790), Sandford, G., 'The early life of the historian, Sir Archibald Alison, Bart and his connection with Shropshire,' in *Transactions of the Shropshire Archaeological Society*, Vol VII 1884, pp 389-402, p. 390.

<sup>957</sup> Watts, R., *Women in science: a social and cultural history* (London, 2007), p. 68.

## 6.6 Case Study- The Ladies of Science

Image: 6/4



'Death's Head Moth and Caterpillar' a watercolour by Katherine Plymley, Shrewsbury Museum Service, ref: 4447

Cultural historians have considered the involvement of women in natural philosophy in Enlightenment England to be centred on the proposition that science was a 'polite subject.'<sup>958</sup>

It met the criteria of promoting virtue and taste; it accentuated aesthetic and moral values and, significantly; it promoted sociability and secured social approval.<sup>959</sup> For some the

<sup>958</sup> For example: Brewer, J., *The Pleasures of the Imagination: English culture in the eighteenth-century* (London, 1997), pp. 100-107; Walters, A.N., 'Conversation pieces: Science and politeness in eighteenth-century England,' *History of Science*, June 1997, 35, 2, pp. 121-154.

identification of the design and workings of God through science was seen as justification for its study.<sup>960</sup> As such it was considered to be an appropriate form of diversion for women but one that did not challenge their traditional role: its location within the domestic environment equally rendered the activity attractive for women.<sup>961</sup> In some settings it was seen to divert attention from more superficial, and potentially costly, pastimes such as card playing and the theatre.<sup>962</sup>

A feature of the concept of politeness was the requirement for social discourse; the sharing with others of details of one's interests, acquired knowledge and expressions of refinement.<sup>963</sup> Alice Walters considers that the popularisation of science amongst women reflected the part played by them in that discourse.<sup>964</sup> She argues that in a social setting, women were frequently the guiding influence in the direction of particular dialogues. Consequently an appropriate level of knowledge upon current issues and subjects such as science would have been advantageous in the conduct of that role. Such may have been the case for the *salonnières* or in metropolitan social settings, but there should not be a presumption that adherence to social propriety acted as the principal reason for women undertaking philosophical study in all situations. Katherine Plymley's diaries record instances during the visits of friends or acquaintances, where knowledge dissemination seems to have been of particular importance: Joseph Babington spoke to the family on astronomy and atmospheric gases, Robert Townson, on minerals.<sup>965</sup> From her notes they seem not to have arisen from any adherence to prescribed social form but specifically with the aim of advancement of knowledge in a particular context.

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<sup>959</sup> Walters, A.N., 'Conversation pieces: Science and politeness in eighteenth-century England,' *History of Science*, June 1997, 35, 2, p. 129.

<sup>960</sup> Walters, A.N., 'Conversation pieces: Science and politeness in eighteenth-century England,' *History of Science*, June 1997, 35, 2, p. 129; Dahn, J., *Women and taste: a case study of Katherine Plymley (1758-1829)*, unpublished PhD thesis, University of Wales, Aberystwyth, 2001, p. 98.

<sup>961</sup> Wakefield, P., *An Introduction to Botany*, cited in Shteir, A. B., *Cultivating Women, Cultivating Science: Flora's Daughters and Botany in England, 1760 to 1860* (Baltimore, 1996), p. 86.

<sup>962</sup> Ferguson, J., *The young gentleman and lady's astronomy* (Dublin, 1792), p. 45.

<sup>963</sup> Brewer, J., *The Pleasures of the Imagination: English culture in the eighteenth-century* (London, 1997), p. 107.

<sup>964</sup> Walters, A.N., 'Conversation pieces: Science and politeness in eighteenth-century England,' *History of Science*, June 1997, 35, 2, p. 130.

<sup>965</sup> For example Shropshire Archives, Corbett Collection, Katherine Plymley's Diaries, Ref:1066/36, Sept 29<sup>th</sup> 1795 to Oct 23<sup>rd</sup> 1795; Ref: 1066/68, July 14<sup>th</sup>, 1806 to Oct 31<sup>st</sup> 1806.

An overarching attribution of ‘politeness,’ would therefore be misplaced. The view espoused by Walters that ‘polite science owed more to politeness than to science,’ is a generalisation that is not sustainable in such circumstances.<sup>966</sup>

Samantha George offers another perspective. She claims that despite being pressed to venture outdoors in the pursuit of knowledge of the natural world, through the works of such as Jean-Jacques Rousseau, Priscilla Wakefield (1751-1832) and others, the display by women of their scientific accomplishments, was discouraged.<sup>967</sup> It represents a contradiction in what was considered acceptable engagement by women within the different elements of the private and public spheres. It may in part explain the lack of evidence recorded in diaries of women science enthusiasts of how their philosophical interests were conducted: a reluctance for self-promotion or glorification, even in a private journal. Katherine Plymley makes only two references to observations carried out, and those in one of her study notebooks.<sup>968</sup> John Brewer defines politeness as a philosophy encompassing manners and conduct: it incorporated self-discipline and the adoption of a defined set of values.<sup>969</sup> For many participants, however, science transcended social requirements of display and approbation. The Quaker author Wakefield, tied botany to a philosophy of self-improvement although she acknowledged that it represented a socially acceptable ‘accomplishment.’<sup>970</sup>

Where discernible, the reasons for adoption of philosophical interests were diverse and the examination of individual cases is therefore a necessity. As highlighted elsewhere in the thesis, local specificity was frequently determinative in such respects. Like Derbyshire, Shropshire was topographically rugged and the accessibility of minerals led to local

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<sup>966</sup> Walters, A.N., ‘Conversation pieces: Science and politeness in eighteenth-century England,’ *History of Science*, June 1997, 35, 2, p. 146.

<sup>967</sup> George, S., ‘Epistolary Exchange: the Familiar Letter and the Female Botanist, 1760-1820,’ *Journal of Literature and Science*, Vol 4, No 1 (2011), pp. 12-29; Fitton S., *Conversation's on Botany* (London, 1817), pp. Viii-ix.; Rousseau, J.-J., *Letters on the Elements of Botany, Addressed to a Lady...translated into English by Thos Martyn*, 2<sup>nd</sup> Ed. (London, 1817); Wakefield, P., *An Introduction to Botany* (London, 1796), p.77.

<sup>968</sup> Shropshire Archives, Corbett Collection, Katherine Plymley’s Diaries, Ref:1066/176.

<sup>969</sup> Brewer, J., *The Pleasures of the Imagination: English culture in the eighteenth-century* (London, 1997), p.101.

<sup>970</sup> Shteir, A. B., *Cultivating Women, Cultivating Science: Flora's Daughters and Botany in England, 1760 to 1860* (London, 1996), p. 86.

popularity of geology and mineral collection in both counties.<sup>971</sup> The individuals identified below appear to have been stimulated for different reasons to pursue their scientific interests, although the notion that politeness functioned as a validation of decisions relating to cultural activity cannot be discounted. Shteir notes that daughters were influenced by the accessibility to science afforded by their fathers, which for some became a lifelong passion.<sup>972</sup> She cites Anna Blackburne (1726-1793), of Orford Hall, Warrington, who worked with her father, John, a horticulturalist. She earned the affirmation of Carl Linnaeus and Erasmus Darwin, who described her in his *System of Vegetables* as ‘learned and ingenious.’ Amongst the Shropshire women who adopted science as a pursuit, Katherine and Ann Plymley, gained an appreciation of natural history and skill in painting from their father, Joseph, who although an apothecary by profession, had been a skilled illustrator of natural history subjects. In considering the work of women in medical science, Ruth Watts questions whether women relatives would have been unseen contributors to the work undertaken by apothecaries.<sup>973</sup> Plymley’s diaries note that the sisters assisted their father in his practice: Ann in particular with the preparation of medicines. According to Katherine, Ann had ‘real knowledge learnt by practice from my father.’<sup>974</sup> It was something that she continued to provide for local people after her father’s death.<sup>975</sup> Frances Stackhouse was another who undoubtedly benefitted from parental influence and until her marriage she was companion and assistant to her father, Thomas Knight of Downton Castle, who became president of the Horticultural Society.

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<sup>971</sup> See Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850* (Manchester, 2009), pp.-142-5 & this thesis, pp. 153, 215,219.

<sup>972</sup> Shteir, A. B., *Cultivating Women, Cultivating Science: Flora's Daughters and Botany in England, 1760 to 1860* (London, 1996), p. 53.

<sup>973</sup> Watts, R., *Women in science: a social and cultural history* (London, 2007), p. 67.

<sup>974</sup> Shropshire Archives, Corbett Collection, Katherine Plymley’s Diaries, Ref:1066/79- (17/8/1809-29/11/1809).

<sup>975</sup> Shropshire Archives, Corbett Collection, Katherine Plymley’s Diaries, Ref:1066/86- (3/3/1811-29/6/1811).

By the middle of the eighteenth-century natural philosophy was established in educated society as a feature of the domestic environment.<sup>976</sup> In the 1740s *The Female Spectator* proclaimed that: ‘Any woman could make herself scientifically literate.’<sup>977</sup> Accommodation was afforded to women to attend science lectures, as was addressed earlier in the chapter. The itinerant lecturers recognised the audience potential arising from females; they modified their course content and its presentation, Francis Midon, for example, acceding to requests for separate courses for women, to overcome social sensibilities. They made efforts to stimulate interest by concessionary fee rates and their encouragement of women to attend what they claimed to be a socially acceptable event. As much as some women, and men, wanted to be seen at a fashionable social occasion, for others they were an entertainment, informative or part of the process of self-improvement. From the mid-1820s the emergence of Mechanics’ Institutions led to significant numbers of women attending lectures. In Derby, lectures at the Mechanics’ Institute were arranged specifically for women with due regard given to the appropriateness of the presentation and subject matter.<sup>978</sup> In Sheffield, at weekly lectures on science, estimated attendances of 200 men and 100 women were recorded.<sup>979</sup> Unfortunately the audiences for the lectures held at the Shrewsbury Mechanics’ Institute were not noted within the minute book.

Formal scientific organisations remained largely inaccessible to women, but on a local level the membership records of the Shropshire Natural History Society for 1835/6 identify twenty-one female members in a total membership of 174 (see fig. 6/2). Frances Stackhouse Acton and Lady Hill of Hawkestone are the most socially prominent female members, the former having extensive interests in natural history as displayed below. Searches have not identified

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<sup>976</sup> Secord, J. A., ‘Newton in the Nursery: Tom Telescope and the philosophy of tops and balls, 1761-1838,’ *History of science*, xxiii (1985), pp.127-151; Watts, R., *Women in science: a social and cultural history* (Abingdon, 2007), p. 68.

<sup>977</sup> Cited in Dobbs, E. J. Teeter and Jacob, M. C., *Newton and the culture of Newtonianism* (New York, 1998), p. 92.

<sup>978</sup> Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850* (Manchester, 2009), p.225

<sup>979</sup> Holland, G. C., *The vital statistics of Sheffield* (1843), pp. 230-236 in Inkster, I., *Scientific Culture and Urbanisation in Industrialising Britain* (Aldershot, 1997), p.460.

the nature and level of the interest by any of the other women members. The number of unmarried women who had membership illustrates the progress made by women in their utilisation of the public sphere. In 1812 Katherine Plymley had declined to attend a public speech given by her brother due to issues of social propriety: that being the likelihood of there being no other females present.<sup>980</sup>

**Fig. 6/2:**

Mrs Stackhouse Acton (Acton Scott).

Miss Bradbridge (Shrewsbury); Mrs Bather (Meole Brace); Miss Catharina Bowman (Shrewsbury); Mrs Basnett (Shrewsbury).

Miss Eaton (Shrewsbury).

Lady Hill (Hawkestone).

Mrs Kough (Shrewsbury).

Mrs John Lloyd (Council House); Mrs Lloyd (Aston).

Mrs Mucklestone (Walford); Mrs Matthews (Shrewsbury).

Miss Niccolls (Shrewsbury)

Mrs Peters (Shrewsbury); Miss Powle (Shrewsbury).

Mrs Swainson (Wistanstow); Miss Spearman (?); Mrs Spiller (Shrewsbury)

Mrs Watkins (Shotton); Mrs Wade (Council House); Miss Williams (Abbey Frigate).

**Female members of the Shropshire and North Wales  
Natural History Society- 1835/6**

Summarised from the Shropshire and North Wales Natural History and Archaeological Society List of Members- Shropshire Archives Ref: 6601/52/4981.

Attitudes amongst progressive individuals and dissenting populations to equality in education for women have previously been commented upon. In 1797 in a treatise on the education of

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<sup>980</sup> Shropshire Archives, Corbett Collection, Katherine Plymley's Diaries, Ref:1066/92.

women, Robert Darwin's father, Erasmus, promoted the advantages to women of an interest in the sciences.<sup>981</sup> Declaring they may 'not only afford them present amusement, but might enable them...to prosecute any of them further if inclination and opportunity should coincide,' he directed them to the itinerant philosophers from whom, 'an outline of the sciences...may be acquired by attending lectures in experimental philosophy.' Changes in the educational opportunities for some women and increasing numbers of published works by female authors saw the gradual extension of personal involvement in science and their presence at gatherings where science-related issues were presented or discussed. Anything other than conditional membership of organisations such as philosophical societies took a lot longer to achieve.<sup>982</sup> A roll-call of campaigners including Mary Wollstonecraft, Maria Edgeworth, Jane Marcet and Mary Somerville promoted the rights of females to be taught science and in Shropshire the provision of private tuition in science by Hon. Thomas Kenyon MP (1780-1851) and his wife for their daughter, demonstrates the encouragement afforded by progressive parents to their female children to partake in philosophical studies.<sup>983</sup> Kenyon was involved as sometime President and committee member of the Shropshire General Agricultural Society, with its role in the dissemination of agricultural science and good practice. He was also a member of the Shropshire Natural History Society. His wife, Louisa Charlotte (née Lloyd), left diaries containing references to her attachment to the study of geology.<sup>984</sup> Both therefore exhibited affiliation with fashionable or cultural manifestations of science. In May 1822 a course of twelve lectures on the 'Elements of Chemical Science' was given by the itinerant lecturer

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<sup>981</sup> Darwin, E., *A plan for the conduct of female education in boarding schools* (Derby, 1797).

<sup>982</sup> Watts, R., *Women in science: a social and cultural history* (London, 2007, p. 102.

<sup>983</sup> Birmingham Archives and Heritage, Ref: Store A087, 1/1797DAR/ SIS collections, Darwin, E., *A plan for the conduct of female education in boarding schools* (reprinted Wakefield, 1968, original 1797); Ref: A942.073SCH, Schimmelpenninck, Mary Anne, *The life of Mary Anne Schimmelpenninck* (London, 1858); Ferguson, James, *An easy introduction to astronomy for young gentlemen and ladies* (London, 1790.

<sup>984</sup> Shropshire Archives, Ref: 549/ 253-257, 'Diaries of Louisa Charlotte Kenyon

John Murray (1785-1851) to Mary Kenyon aged twelve.<sup>985</sup> The course covered crystallization, heat and light, electricity, fire, gases, alkalis, metals, vegetable chemistry and fermentation. It is not an introduction to 'polite science.' The encouragement of her parents and the advantages of her social standing would afford Mary the opportunity to develop any interest in natural philosophy to her best advantage but within three years she was dead, at the age of fifteen.

The identification of those women who undertook an interest in natural philosophy for reasons other than social propriety is challenging and requires a greater investment of time in the examination of extant diaries and epistolary collections in particular. Amongst the women of Shropshire there are several in respect of whom records exist, albeit of a limited extent.

### **6.6.1 Katherine Plymley**

The diaries of Katherine Plymley have proved an important source in this study and in the current chapter highlight the significance of aspects of scientific endeavour within a particular social grouping. She recorded the satisfaction that she took from the information imparted by visitors: Dugard on chemistry and mineralogy, Aiken and Townson on mineralogy and geology, Wilding and Babington on botany and John Stackhouse on botany and seaweeds, upon which he was a published expert.<sup>986</sup> When Robert Townson emigrated to Australia in 1806 his collection of specimens and books were deposited with the Plymleys.<sup>987</sup> "One Laundry & Book room were full of the different packages." They included rare plants from his travels in Hungary, Germany, Norway, Switzerland, France, Italy as well as Britain. "My sister gave him much assistance...I was busily employed in taking the opportunity of painting

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<sup>985</sup> Shropshire Archives, Ref: 549/347-50, 'Syllabus of a course of lectures on the Elements of Chemical Science' by John Murray F.L.S., M.W.S.

<sup>986</sup> Shropshire Archives, Corbett Collection, Katherine Plymley's Diaries, Ref:1066/.

<sup>987</sup> Shropshire Archives, Corbett Collection, Katherine Plymley's Diaries, Ref:1066/68, July 14th 1806 to Oct 31<sup>st</sup> 1806.

some rare Butterflies...In all there are twenty eight large boxes, besides the great number of small boxes of insects packed up in a large one."<sup>988</sup>

During a visit in 1795, Dr Joseph Babington read aloud a philosophical essay by Hugh Hamilton on the ascent of vapours, offering comments and explanations of the content.<sup>989</sup> He had also brought a collection of many hundreds of dried plants for the family to see, which Katherine declared great pleasure in examining. The following night he spoke on astronomy and explained the distance between the stars and the Earth and the length of time it took light to travel. He entertained the children instructing them in aspects of natural philosophy at every opportunity. He also notated Hamilton's book of essays and left it for them to consider, saying he would attempt to answer any questions the next time he called. Babington expressed his own satisfaction in being able to consider the works of nature in the context of the 'design of the Great Creator,' a teleological reflection that would undoubtedly have found favour with the Plymleys. During such visits social form was undoubtedly preserved but the examination of personal collections and the transmission of knowledge were not merely enacted in the search for social approbation. The diaries make clear the interest in the pursuit of knowledge. They repeatedly confirm the benefit accruing from these associations to the younger members of the family.

Katherine's interest was largely centred upon entomology, although she and her sister Ann maintained an interest in most aspects of natural history and improving studies.<sup>990</sup> It is displayed to great effect in a legacy of more than five hundred watercolour paintings of insects. The content of the paintings generally displayed the insect upon foliage or a food plant, sometimes with different life-stages of a particular creature; caterpillar, chrysalis and

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<sup>988</sup> Shropshire Archives, Corbett Collection, Katherine Plymley's Diaries, Ref:1066/68, Sept 29th 1795 to Oct 23<sup>rd</sup> 1795.

<sup>989</sup> Shropshire Archives, Corbett Collection, Katherine Plymley's Diaries, Ref:1066/36, Sept 29th 1795 to Oct 23<sup>rd</sup> 1795: Hamilton, H., *Philosophical Essays on the following subjects. 1. On the ascent of vapours, the formation of clouds, rain and dew...* (London, 1767 ed).

<sup>990</sup> Dahn, J. 'Plymley, Katherine (bap. 1758, d. 1829)', *Oxford Dictionary of National Biography*, 2004, Online edition, <http://www.oxforddnb.com/view/article/93057>

adult, within the same picture (see Image 6/5). The presentations were clearly staged but she indicates that many of the adult insects were alive when painted. In some instances specimens had been



acquired and 'posed.' Katherine was a competent artist, something undoubtedly learned from her father.<sup>991</sup> Joseph snr. provided a number of illustrations of birds for Thomas Pennant's *British Zoology* and when Pennant's son determined on publishing an updated edition of his father's work he approached Katherine to paint copies of four of her father's original

<sup>991</sup> Dahn, J. 'Plymley, Katherine (bap. 1758, d. 1829)', *Oxford Dictionary of National Biography*, 2004, Online edition, [<http://www.oxforddnb.com/view/article/93057>]

illustrations, which she duly did.<sup>992</sup> She incorporated notes on the rear of many of the paintings: identifying the circumstances surrounding its acquisition, its location, her own observations, which give an indication of organisation and regularity of presentation of information that has a scientific tenor.

She recalled in her diaries that her father drew greatly from the published works of others and had particular regard for Réaumur.<sup>993</sup> He had referred to him as 'a man of genius & a philosopher, he entered minutely into the natural history of the insects he described, and he was equally accurate and entertaining.'<sup>994</sup> Réaumur's *Memoires* displays the thoroughness of his observations and presentation in the context of contemporary knowledge (see Image 6/6).<sup>995</sup> In light of her access to such reference material and her father's declared opinions on its merit, the order that emerges in Katherine's work may be traceable to the influence of Réaumur. A critical review of her methods and influences are undertaken by Joanna Dahn who considers the paintings never conspicuously decorative. She expresses the belief that Katherine felt that her paintings and studies would enhance knowledge of the subject.<sup>996</sup> However, such an outcome would require the paintings to be accessible to others. They were mounted into albums, which may have afforded accessibility and their presentation in a predetermined manner. The education of family members and neighbourhood children were possibly the extent of the utilisation of the paintings for knowledge advancement. There is no reference in her diaries to them being shown and discussed with visitors or presented to a wider audience. A purpose she ascribed to her studies was to be better informed so that she

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<sup>992</sup> Shropshire Archives, Corbett Collection, Ref: 1066/86, Katherine Plymley's Diaries, May 8<sup>th</sup> to June 29<sup>th</sup> 1811.

<sup>993</sup> René Antoine Ferchault de Réaumur (1683-1757).

<sup>994</sup> Shropshire Archives, Corbett Collection, Ref: 1066/140, Katherine Plymley's Diaries, 'Memoirs of my Father, No. 2.'

<sup>995</sup> University of Birmingham Cadbury Library, Ref: QL462.R23, Réaumur, René Antoine Ferchault de (1683-1757), *Memoires pour servir à la histoire des insectes*, Vol. 2, pp. 293-7, (Paris, 1742).

<sup>996</sup> Dahn, J., *Women and taste: a case study of Katherine Plymley (1758-1829)*, unpublished PhD thesis, University of Wales, Aberystwyth, 2001, pp. 117-20.

and her sister could provide instruction to her brother's children, a responsibility they had assumed when his first wife had died.<sup>997</sup>

Image: 6/6



From Réaumur, R. A. Ferchault, *Memoires pour servir à la histoire des insectes*, Vol. 2 (Paris, 1742), p. 293.

Following a family visit to the Rev. Richard Wilding, her nephew, Waties, expressed the desire to be taught botany. The day had been spent examining numerous volumes of 'Curtis's

<sup>997</sup> Shropshire Archives, Corbett Collection, Ref: 1066/14, Katherine Plymley's Diaries.

Botany' and having the contents explained.<sup>998</sup> His tutor reported, 'Mr Wilding has done more in one day, than I could do in all the time Waties has been with me. I could never, though I wished it, give him a turn for botany.'<sup>999</sup> A number of the younger members of the Plymley family accompanied Katherine when she attended a course of chemistry lectures given by Dr Thomas Dugard at the Shropshire Infirmary.<sup>1000</sup> Amongst them were Josepha, Jane and Helen. The intention was clearly not to restrict the girls to those polite subjects that befitted genteel females. Their father, the Archdeacon, raised no objections, indeed had she not fallen ill, their mother had also planned to attend. The process afforded the young attendees the opportunity for intellectual development in a manner suited to the broadening horizons offered by an improving or enlightened age.

In addition to diaries and travel journals, Katherine Plymley left a series of study notebooks but in the main they contain extracts or critiques of readings undertaken: they contain few references to the process of engagement in scientific study. A case study that is cited, details attempts to hatch a 'death head moth.'<sup>1001</sup> She notes attempts previously made to hatch the moths either from caterpillar or chrysalis forms; where they originated from; the conditions in which they were kept; third-party references accessed for guidance in the process; she made observations on changes in the creatures' structure and colour; and ultimately recorded the opening of the chrysalis and the emergence of the moth. She notes painting different aspects of the moth that hatched and how it was kept until released. The notes are ordered and may be considered scientific in a naive way that is in keeping with the time and experience of the individual. In the same notebook she also systematically records observations taken of the death of a queen bee and of other bees within the hive.

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<sup>998</sup> *Curtis's Botanical Magazine*, first published in 1787, it continues to be published by the Royal Botanical Gardens, Kew.

<sup>999</sup> Shropshire Archives, Corbett Collection, Ref: 1066/78, Katherine Plymley's Diaries.

<sup>1000</sup> Shropshire Archives, Corbett Collection, Ref: 1066/62, Katherine Plymley's Diaries, 29th March 1804 to 21st Nov 1804.

<sup>1001</sup> Shropshire Archives, Corbett Collection, Ref: 1066/176, Katherine Plymley's Diaries. See the illustration at the beginning of this case study.

Katherine Plymley's interest in natural philosophy seems profound but is there a degree to which she was following fashionable prescription? It seems unlikely. She questioned whether she was acting selfishly over her attention to her pastime. In the diary July 1813- Feb 1814 she writes:

...It has at different periods of my life occupied a good deal of my time, I sometimes fear too much, but the Almighty has given different inclinations, &, if I may say so when speaking of myself, different talents. I still go on, &, hope I am not sinning in doing so.<sup>1002</sup>

Her notes on moral standards, particularly those associated with the hypotheses advanced by James Beattie, suggest that the adoption of fashionable tenets did not sit strongly with her.<sup>1003</sup>

Dahn raises the issue of 'feminine dilettantism' and draws in Mrs Delaney, the eighteenth century social commentator, as a contextual reference.<sup>1004</sup> She also refutes the likelihood of

Plymley being swayed by considerations of fashion. Beattie argued the cause of self-improvement which may have conditioned her attitudes given the regard she displays in her study journals for his philosophy.<sup>1005</sup> In the second half of the eighteenth-century there were

increasing examples of women emerging into the public sphere: writing for publication and attending events, particularly if there were expectations that other women would be

present.<sup>1006</sup> Katherine wrote of visiting art exhibitions and museums, of her trips to London and Oxford. But although being in some ways progressive in her attitudes she was careful not to be seen to be challenging convention.<sup>1007</sup>

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<sup>1002</sup> Shropshire Archives, Corbett Collection, Ref: 1066/100 Katherine Plymley Diaries.

<sup>1003</sup> Robinson, R. J., 'James Beattie (1735-1803),' *Oxford Dictionary of National Biography*, 2004, Online edition, (<http://www.oxforddnb.com/view/article/1831>); Beattie, J. M., *Dissertations Moral and Critical*, (London, 1783); Shropshire Archives, Corbett Collection, Ref: 1066/152, Katherine Plymley's Diaries

<sup>1004</sup> Schnorrenberg, B. B., 'Delany, Mary,' *Oxford dictionary of national biography* (Oxford, 2004), online edition, (<http://www.oxforddnb.com/view/article/7442>); Dahn, J., *Women and taste: a case study of Katherine Plymley (1758-1829)*, unpublished PhD thesis, University of Wales, Aberystwyth, 2001, pp. 117-20..

<sup>1005</sup> Dahn, J., *Women and taste: a case study of Katherine Plymley (1758-1829)*, unpublished PhD thesis, University of Wales, Aberystwyth, 2001, p. 20.

<sup>1006</sup> Dahn, J., *Women and taste: a case study of Katherine Plymley (1758-1829)*, unpublished PhD thesis, University of Wales, Aberystwyth, 2001, p. 25-6.

<sup>1007</sup> Dahn, J., *Women and taste: a case study of Katherine Plymley (1758-1829)*, unpublished PhD thesis, University of Wales, Aberystwyth, 2001, p. 26.

Earlier in this chapter attention was drawn to her attendance at science lectures presented by Thomas Dugard. The emergence of new forms of knowledge cannot have failed to have taken the attention of someone with an enquiring mind, particularly when coming into contact with those who were happy to share their own enthusiasm. Katherine reflected that there was frequently a moment or event that diverted individuals onto a particular course.<sup>1008</sup> She likened it to her father's situation when, having viewed 'Mr Mores collection of paintings of birds,' he was driven to begin his own collection. The opportunities that were afforded to Katherine and her sister by the progressive attitude of their father, to pursue natural history as an interest; to acquire those particular skills needed to enhance its study, were transmitted to the next generation.

#### **6.6.2 Frances Stackhouse Acton**

Frances Stackhouse became a friend of Katherine Plymley shortly after she and her husband, Thomas Pendarves Stackhouse (1778-1835), moved into the house at Acton Scott. The extent to which she was involved in cultural or polite science is not substantiated by surviving personal sources, however an obituary published shortly after her death in 1881 confirms: 'She was an accomplished artist and authoress, and possessed a wide knowledge of geological, botanical, horticultural, and antiquarian lore; and, above all these accomplishments, was distinguished for great goodness of heart, and an unceasing generosity and kindness to her poorer neighbours.'<sup>1009</sup> It can be no surprise, given the formative influences that she was exposed to, that she succumbed to an engagement with natural philosophy. Her botanical connections from an early age were exceptional. Her father was Thomas Andrew Knight of Downton Castle, Herefordshire (1759-1838). He engaged in the empirical study of plant philology and horticulture, was a Fellow of the Royal Society and

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<sup>1008</sup> Shropshire Archives, Corbett Collection, Ref: 1066/78, Katherine Plymley's Diaries.

<sup>1009</sup> *The Gardner's Chronicle*, 5th Feb 1881, pp. 182-3

became the President of the Royal Horticultural Society.<sup>1010</sup> Her uncle, Richard Payne Knight, promoted the ‘picturesque’ form of beauty in landscape design and was considered an authority on ‘taste’ and aesthetics.<sup>1011</sup> Her father-in-law, John Stackhouse, was a leading authority on seaweeds and botany generally visiting Acton Scott for three or four months a year.<sup>1012</sup> Thomas’s cousin, Emily (1811-1870), was to become a noted botanical artist with over six hundred paintings in her portfolio.<sup>1013</sup> Amongst the regular visitors in her youth was Humphrey Davy, a friend with whom Knight conducted experiments.<sup>1014</sup> Frances noted that: ‘...he & my father tried some experiments by passing rays of light through glass of different colour on a piece of white leather which had been washed over with Nitrate of Silver. The object I believe was to ascertain whether the amount of heat was affected by the coloured medium.’ She recalled that it had a similarity with the later invention of photography. In 1809, she and her father visited the home of Sir Joseph Banks at Hounslow, ‘a long and intimate friend of father, and an encourager of his researches in vegetable Physiology.’<sup>1015</sup> She wrote a short memoir, encouraged by her nieces, which provides interesting contexts for different phases of her life but there is no reference to interest in horticulture, botany or geology.<sup>1016</sup> That may have been a situation well-understood by her nieces and therefore excluded. The memoir does record that as children they were taught to love nature, to handle reptiles and insects and to observe how ‘wonderfully & beautifully each one was adapted to fit its place in the scheme of creation.’<sup>1017</sup> Frances does note, however, that she had drawing lessons as a girl and that she helped her father by copying the papers he sent to the Royal

<sup>1010</sup> Browne, J., ‘Knight, Thomas Andrew (1759-1838),’ *Oxford Dictionary of National Biography* (Oxford, 2004), online edition, May 2014, (<http://oxforddnb.com/view/article/15737>)

<sup>1011</sup> Stumpf-Condry, C. and Skedd, S. J., ‘Knight, Richard Payne (1751-1824),’ *Oxford Dictionary of National Biography* (Oxford, 2004), online edition, May 2014, (<http://oxforddnb.com/view/article/15733>).

<sup>1012</sup> Price, J., ‘Stackhouse, John (bap 1742- 1819),’ *Oxford Dictionary of National Biography* (Oxford, 2004), online edition, May 2014, (<http://oxforddnb.com/view/article/15733>).

<sup>1013</sup> Hardie-Budden, M., ‘Stackhouse, Emily (1811-1870),’ *Oxford Dictionary of National Biography* (Oxford, 2004), online edition, May 2014, (<http://oxforddnb.com/view/article/98100>).

<sup>1014</sup> Shropshire Archives, Ref: 6683/4/114, ‘Frances Stackhouse Memoir,’ p.18.

<sup>1015</sup> Shropshire Archives, Ref: 6683/4/114, ‘Frances Stackhouse Memoir,’ p. 10.

<sup>1016</sup> Shropshire Archives, Ref: 6683/4/114, ‘Frances Stackhouse Memoir.’

<sup>1017</sup> Shropshire Archives, Ref: 6683/4/114, ‘Frances Stackhouse Memoir,’ p.6.

Society and the Horticultural Society.<sup>1018</sup> That she was a skilled painter was attested to by Katherine Plymley: ‘I had the gratification of seeing some of her own drawings. She excels in painting fruit in watercolours.’<sup>1019</sup> Plymley comments on the illustrations ‘Fanny’ Stackhouse

**Image: 6/7**



**Acton Scott Hall from the south’ by Frances Stackhouse Acton, by permission of Acton Scott Working Farm**

had provided for her father, Thomas Knight’s book, *Pomona Herefordiensis*, which Ray Desmond attests to in his dictionary.<sup>1020</sup> There are also references to her illustrations being utilised in the earliest editions of Davy’s *Salmonia*. A digitised version of the 1828 edition has a woodcut of Downton Castle but there is no attribution that confirms this was produced from

<sup>1018</sup> Shropshire Archives, Ref: 6683/4/114, ‘Frances Stackhouse Memoir,’ p. 15.

<sup>1019</sup> Shropshire Archives, Corbett Collection, Ref: 1066/100 Katherine Plymley Diaries- July 31st to Feb 17th 1814.

<sup>1020</sup> Desmond, R., ‘*Dictionary of British and Irish Botanists and Horticulturalists including plant collectors, flower painters and garden designers*, (1977)

Stackhouse's original.<sup>1021</sup> Her competence as a watercolourist is seen in the studies that she produced of her home Acton Scott and several other publications (see Image 6/7).<sup>1022</sup>

The pleasure grounds laid out around Acton Scott Hall in the fifteen years following the arrival of Fanny and her husband in 1812, anticipated the 'gardenesque' style propounded by John Claudius Loudon.<sup>1023</sup> Flower beds were dug into the bowling green, specimen trees were planted and a shrubbery established; walks and drives were laid out; and over 35,000 trees were planted around the estate. Paul Stamper considers that the Stackhouses may be responsible for the designs employed, given the family backgrounds of both of them. If so it displays both 'improving' and progressive attitudes: the utilisation of existing horticultural knowledge and the application of empirical practices to further that knowledge; the provision of resources to promote wealth creation for future generations; and the adoption of culturally advanced forms of garden design. All of which would have clearly been amplified by studies of the science that underlay them.

She also exhibits an interest in architectural archaeology, having been instrumental in securing the excavation of a Roman villa close to Acton Scott: she had books published on the local examples (see Image 6/8).<sup>1024</sup> That she had improving sensibilities in a wider context is demonstrated by the establishment of her own charity, by the funding of a local school and by her contribution to the rebuilding of formerly distressed cottages for local people.<sup>1025</sup>

### 6.6.3 Lady Henrietta Clive

When in India during her husband's governorship of Madras from 1798-1801, Lady Henrietta Clive (1758-1830) travelled extensively, collecting along the way, plants, trees, rocks,

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<sup>1021</sup> Davy, H., *Salmonia: Or Days of fly fishing in a series of conversations...*, <http://www.books.google.co.uk>.

<sup>1022</sup> Discover Shropshire History, <http://www.discovershropshire.org.uk/>; *The Castles and Old Mansions of Shropshire; Thirteen View of the Castle of St Denet's, Glamorganshire*.

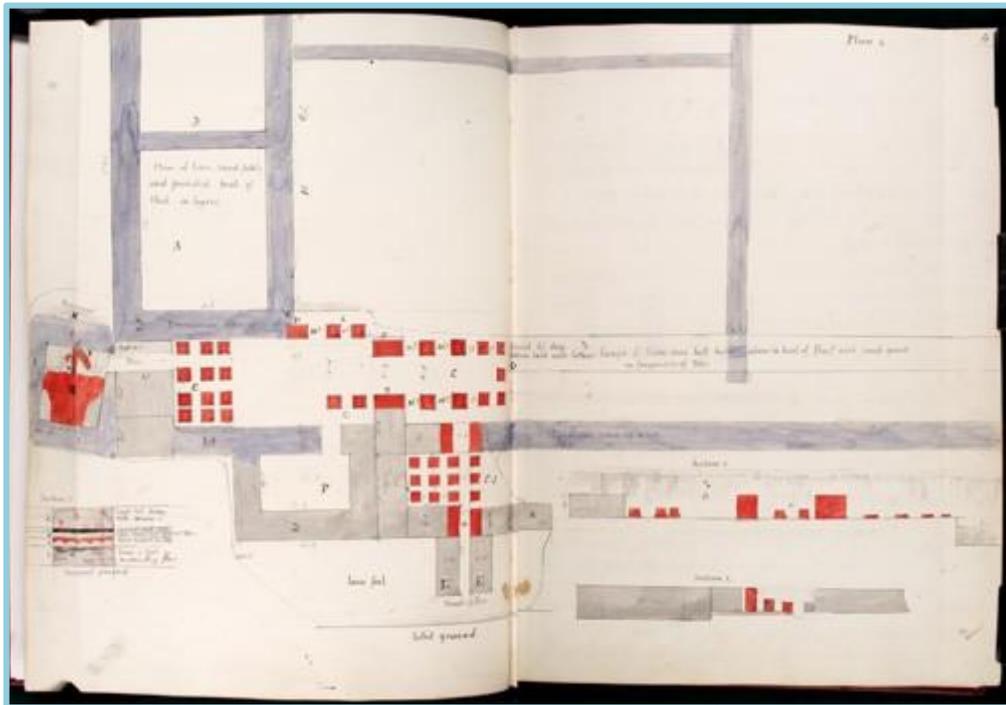
<sup>1023</sup> Stamper, P., *Historic Parks and Gardens of Shropshire* (Shrewsbury, 1996), p.74.

<sup>1024</sup> See *Garrisons of Shropshire during the Civil War and Castles and Old Mansions of Shropshire* (nd).

<sup>1025</sup> <http://www.discovershropshire.org.uk/>

animals, birds, butterflies and shells and forwarding them to her husband in Madras.<sup>1026</sup> She discovered previously unknown species including *Caralluma umbellata*, which she donated to the Calcutta Botanical Gardens. Whilst in India she sought to converse with any naturalist that

Image: 6/8



**Archaeological drawing of a Roman villa at Acton Scott by Frances Stackhouse Acton, Shrewsbury Museum Services**

she encountered, seeking to enhance her own knowledge, particularly of local species.<sup>1027</sup>

Lady Clive reputedly had a great interest in botany and horticulture, a subject that she shared with her husband and he and their sons became noted ‘improvers’ of the family estates.<sup>1028</sup>

Lord Clive himself, had been appointed to the Board of Agriculture in 1793.<sup>1029</sup> During her tour in the sub-continent she was accompanied by her two daughters, aged 13 and 14 and made a point of ensuring that their daily tuition contained elements of study of the local flora,

<sup>1026</sup> Shields, N. K., *Birds of Passage: Henrietta Clive's travels in South India, 1798-1801* (London, 2009), p. 38.

<sup>1027</sup> Shields, N. K., *Birds of Passage: Henrietta Clive's travels in South India, 1798-1801* (London, 2009), p. 35.

<sup>1028</sup> Herbert, E. W., *Flora's Gardens, British Gardens in India* (Pennsylvania, 2011); See Chapter 5 re improvement of Clive estates.

<sup>1029</sup> Prior, D. L., ‘Clive, Edward, first earl of Powis (1754–1839)’, *Oxford Dictionary of National Biography* (Oxford, 2004); online edn, May 2009, <http://www.oxforddnb.com/view/article/5696>.

fauna and minerals.<sup>1030</sup> It was a progressive attitude towards the education of girls and young women, seeking to assist them in the broadening of their horizons and it reflected the frustration that she herself felt over the constraints placed upon contemporary women; particularly those with active and inquisitive minds. In a letter to her husband expressing her pleasure at the prospect of engaging in collecting specimens, she added the rider, ‘it is hard that we poor females are not to get anything in this Asiatic world.’<sup>1031</sup>

To what extent this interest was retained upon her return to Shropshire has not been established and it reinforces earlier notes made of the opportunities existing for additional research within the substantial Clive collection at Shrewsbury. The collecting of minerals that she undertook in India was continued once home and she established a notable collection.<sup>1032</sup> Her children contributed and she purchased and exchanged items with other collectors. Detailed cataloguing utilising a numbering system and identification labels on items, indicated a high degree of organisation. The information contained in the catalogue entries is also extensive.<sup>1033</sup> Approximately a quarter of the collection still exists and is lodged at the National Museum of Wales.<sup>1034</sup>

#### **6.6.4 Louisa Charlotte Kenyon**

Louisa Kenyon was also a friend of Katherine Plymley, the two ladies travelling together in Wales and recording their journey in travel diaries. The wife of the Hon. Thomas Kenyon MP, she engaged in many pursuits. She had a considerable collection of fossils and minerals, and was deeply interested in botany and drawing.<sup>1035</sup> She expressed concerns for the welfare of neighbours, supported the local church, school and charitable societies. The progressive

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<sup>1030</sup> Shields, N. K., *Birds of Passage: Henrietta Clive's travels in South India, 1798-1801* (London, 2009), p. 34.

<sup>1031</sup> Shields, N. K., *Birds of Passage: Henrietta Clive's travels in South India, 1798-1801* (London, 2009), p. 35.

<sup>1032</sup> Cotterell, T., ‘The early 19<sup>th</sup> century systematic mineral collection of Lady Henrietta Antonia Clive, Countess of Powis: an important new discovery,’ 7<sup>th</sup> International Conference on Mineralogy and Museums at Dresden,

<sup>1033</sup> Cotterell, T., ‘The early 19<sup>th</sup> century systematic mineral collection of Lady Henrietta Antonia Clive, Countess of Powis: an important new discovery,’ 7<sup>th</sup> International Conference on Mineralogy and Museums at Dresden,

<sup>1034</sup> Cotterell, T., *The fabulous mineral collection of Henrietta Antonia Clive, Countess of Powis*, National Museum of Wales, 2012.

<sup>1035</sup> Shropshire Archives, Ref: 549/331, ‘Kenyon Family Pedigree,’ p.51.

attitude that she and her husband had to their children's education was mentioned above and as with the other women highlighted in this section she reflects enlightened views inherited from her father. The Reverend John Robert Lloyd of Aston in Shropshire was an estate 'improver,' planting 50,000 oak seedlings and acorns, clearly for the benefit of future generations.<sup>1036</sup> He was also one of the original promoters of the Ellesmere Canal, constructed on the grounds of enhancing the development of agriculture and the extractive industries.<sup>1037</sup> The diaries of Louisa Kenyon make reference to her geological studies and collection of rocks and minerals but they were withdrawn from archives back into private ownership and to date permission to examine them has not been secured.

The Shropshire women upon whom this case study is based represent a small sample but it indicates that within a largely rural setting there were women pursuing interests in science for reasons other than fashion or social determination. Politeness and sociability may have been reflected in the presentation of their philosophical pastimes to others, but the overriding impression is that the satisfaction arising from accomplishment and knowledge acquired stimulated the desire to pursue study, painting and collection. As was the case for many middle-class women, those attainments were seen as a benefit in the education of the children that were in their care. Published introductions to science featured amongst the increasing number of works written by women, particularly from the fourth quarter of the eighteenth-century.<sup>1038</sup> Those produced by Frances Stackhouse Acton on architectural history are, however, the only books located that are attributable to a local female author with interest in natural philosophy.

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<sup>1036</sup> Dodd, J. P., *Shropshire Agriculture, 1793-1870*, unpublished PhD thesis, University of London, 1981, p. 87.

<sup>1037</sup> See Chapter 3.

<sup>1038</sup> Shteir, A. B., *Cultivating Women, Cultivating Science: Flora's Daughters and Botany in England, 1760 to 1860* (London, 1996), p. 86.

The influential role played by personal association in the dissemination of knowledge is witnessed in Katherine Plymley's journals. She described how visits, to and by friends and acquaintances, resulted in the exchange of knowledge about subjects of mutual interest: in this case about natural history. Thomas Dugard was the family doctor but social calls regularly incorporated conversations on minerals or nature.<sup>1039</sup> It further develops the view of the importance of intellectual communion in the progress of Enlightenment or 'improvement,' even in the domestic environment.

The work undertaken by the women who are the subjects of this case study is unlikely to have added to the sum total of knowledge within the particular fields concerned. However, they enhanced the knowledge of aspects of the natural world for the participants and some of the people in their immediate circle. As described earlier in the chapter it afforded the possibility of broadening the intellectual and social horizons of those involved.<sup>1040</sup> As Peter Borsay reflects, the notion of 'improvement' as a cultural concept incorporated a desire to 'better the self and the world.'<sup>1041</sup>

Opportunities afforded for the dissemination of knowledge through the medium of their social circle, have been illustrated within this chapter through entries extracted from Katherine Plymley's diaries. It is appropriate, therefore, to consider the extent to which the group of people with whom the Plymleys associated and conversed represented a contemporary node for knowledge interchange as Trinder suggested in 1983.<sup>1042</sup>

## **6.7 The Plymley Dining Table**

The issue of intellectual communities and the scope they afforded for innovation and the communication of ideas are a central feature of this thesis but unlike many of the industrial

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<sup>1039</sup> Shropshire Archives, Corbett Collection, Ref: 1066/63, Katherine Plymley's Diaries, 21<sup>st</sup> March 1804 to 1<sup>st</sup> April 1805.

<sup>1040</sup> See this chapter, p. 210.

<sup>1041</sup> Borsay, P., 'The culture of improvement,' in Langford (ed.), *The Eighteenth Century: 1688-1815* (Oxford, 2002), pp. 183-212; p.184.

<sup>1042</sup> Trinder, B., *A history of Shropshire*, Philimore (London, 1983, 2nd ed 1998), p. 79.

centres, formal societies were frequently slower establishing themselves in county environments such as Shropshire. As has been evidenced in the other substantive chapters much of the process of knowledge acquisition had been initiated as a consequence of people being brought together by circumstance. This had sometimes been occasioned as a result of specific need, as at Pontcysyllte or Ditherington Flax Mill but in other cases people were brought together by social or cultural occurrences. The title of the section is a descriptive device which acts as a framework for identification of examples of social intercourse amongst a group of individuals with a connection to the Plymley family. In doing so it highlights the potential that existed in that context for the dissemination of knowledge of a philosophical nature. References in Katherine Plymley's diaries give cause to believe that association within the Plymley circle was effected predominantly at meal times or when people came to stay, for example: '3rd Sept (1807). I dined at the Hall with a large party today, the Stackhouses, Mr & Mrs Wilding, two Mr Hawkins, Mr Corfield, Mr Rowlands & Mr R Scott.'<sup>1043</sup>

Although the reality undoubtedly differed from that observation, the inference draws parallels with the Lunar Society of Birmingham, where philosophical issues of mutual interest were discussed in a domestic environment by a group of friends and their invited guests. Although the Lunar members also conducted a great deal of their discussions upon philosophical issues through correspondence, it begs the question of whether the Plymley friends and acquaintances reflect the form of creative community of knowledge exchangers attributed to the Lunar membership.<sup>1044</sup> A significant difference lies in there being few formal or regular meetings of the Shropshire gentlemen whereas at Soho, although not constituted as a discrete body, periods of regular gatherings of core members of the group were occasioned over more

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<sup>1043</sup> Shropshire Archives, Corbett of Longnor Collection, 'Katherine Plymley's Journals, Ref: 1066/72, 27<sup>th</sup> August 1807 to 28<sup>th</sup> October 1807.

<sup>1044</sup> Jacob, M. C. and Stewart, L., *Practical Matter: Newton's science in the service of industry and Empire, 1687-1851* (Cambridge, Mass., 2004), p. 59; Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009), p. 82.

than a quarter of a century.<sup>1045</sup> Katherine's diaries are not given over to extensive recording of 'table-talk' but it is apparent that the backgrounds of visitors determined that a wide-range of subjects occupied discussions rather than any single-minded application to 'philosophising.' Grounds claims that Archdeacon Plymley had more than a passing interest in natural history although no references are offered to support the case and observations to that effect have not as yet been identified within his sister's journals. Their father being a keen naturalist and skilled painter of the subject the opportunity was afforded for the development of such proclivities, as it did with his sisters. In terms of the promotion of 'improvement' and social advancement Plymley's credentials are highly visible and many within the circle of acquaintances were undoubtedly associated with Enlightenment ideals.<sup>1046</sup> The exertions on behalf of the anti-slave trade campaign of 1791/2 and in social and civic improvement exemplify that interest and although they stray beyond the determined focus of this chapter they provide appropriate contextual references.<sup>1047</sup>

The Shropshire group of individuals are also a much looser agglomeration than are witnessed at Soho even when taking into account those peripheral members of the Lunar Society such as Wedgwood, Whitehurst and Stokes.<sup>1048</sup> The traceability of contact is frequently difficult to establish, Katherine's journals being the most substantial, but by no means a continuous, source. Communications between individuals are accordingly seen to be linked to specific occasions or visits and not reflective of a dynamic process of improvement or expressions of enlightened convictions emanating from within a group: in the case of the pursuit of abolition of the slave trade, however, they do bear witness to the adoption of a cause. That is not to

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<sup>1045</sup> Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009), pp. 89-94.

<sup>1046</sup> Grounds, D., *Son and servant of Shropshire: the life of Archdeacon Joseph(Plymley) Corbett, 1759-1838* (Herefordshire, 2009), p. 231.

<sup>1047</sup> Shropshire Archives, Ref: 1066/67, Corbett of Longnor Collection, 'Katherine Plymley's Journals,

<sup>1048</sup> Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009), pp. 86-7.

deny the progressive attitudes of individuals who have an association with this group, which have been demonstrated throughout this thesis. In other respects the record of meetings, social occasions and correspondence signify the extent of the adoption of cultural engagement with science.

During the first decade of the nineteenth-century Thomas Dugard features extensively in Katherine's journals, his scientific skills being extolled and he was regularly amongst the guests for dinner at both Longnor Hall, Joseph's home, and Bank House, where Katherine and Ann lived.<sup>1049</sup> Having treated a number of the Plymley family medically, Dugard was looked upon as a family friend and with an enthusiasm for aspects of natural history and geology the opportunity existed for discussions with guests upon mutual interests. '4th Sept (1807) Today we had a party to dinner, seven from Mr Witts's, Mr & Mrs Wilding, just before Mr & Mrs Adams came in...just after our dinner Dr Dugard arrived...and had the goodness to stay & take his tea with us.'<sup>1050</sup>

Plymley's agricultural survey featured contributions from several individuals who shared the hospitality of the family. The Quaker ironmaster, William Reynolds contributed details of the geological sub-strata on the Shropshire Coalfield to the report; Robert Townson also supplied geological information; as previously mentioned, Dr. Joseph Babington provided information on varieties of grass to be found within the county; and a number of the doctors at the Infirmary, including Darwin, Dugard and James Evans, reported upon natural springs and their efficacy.<sup>1051</sup> Earlier reference was made to the regularity of visits of Townson and the mutual affinity for minerals between himself and several of the Plymley household was noted

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<sup>1049</sup> Shropshire Archives, Ref: 1066/60, Corbett of Longnor Collection, 'Katherine Plymley's Journals,

<sup>1050</sup> Shropshire Archives, Corbett of Longnor Collection, 'Katherine Plymley's Journals, Ref: 1066/72, 27<sup>th</sup> August 1807 to 28<sup>th</sup> October 1807.

<sup>1051</sup> Plymley, J., *A general view of the agriculture of Shropshire with observations drawn up for the consideration of the Board of Agriculture and internal improvement*, (London, 1803), pp.53, 60, 67, 69, 73 & 183; also in Grounds, D., *Son and servant of Shropshire: the life of Archdeacon Joseph(Plymley) Corbett, 1759-1838* (Herefordshire, 2009), p. 112.

by Katherine. Reynolds visited in the summer of 1798 and on a later occasion, his widow recounted to Katherine also meeting her brother when he called upon the Reynolds at Ketley.<sup>1052</sup> During his time in Ludlow between 1798 and 1812, Joseph Babington stayed or dined with the Plymley family on several occasions, initially for several days in July 1798. The honour was returned on at least one occasion when the Archdeacon was conducting a visitation to Ludlow.<sup>1053</sup>

The cultural inclinations of many guests are not known other than in the event of Katherine drawing attention to them: in the case of old friends of Plymley such as Theophilus Houlbrooke and Rev. Richard Wilding, to their interest in botany.<sup>1054</sup> A diary entry from 1806 relating to one of the dinners for local magistrates reads: ‘One of the most intelligent & superior characters of our neighbouring gentlemen is a magistrate in this hundred, Mr G. Thursby, he is besides a good naturalist & very ready to communicate his knowledge...’<sup>1055</sup> She subsequently comments: ‘there is something very pleasing in seeing a person this alive to every opportunity of improvement.’<sup>1056</sup> It illustrates the dissemination of knowledge taking place in such an environment and that there was an abiding awareness of improvement as a concept. The geologist Arthur Aikin, together with Dugard, dined with Plymley in August 1809, having expressed his admiration of the latter’s agricultural survey of the county. He had carried out a number of geological studies within the area in anticipation of publishing a geological survey. The exchange of knowledge and opinions over dinner were no doubt

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<sup>1052</sup> Shropshire Archives, Corbett of Longnor Collection, ‘Katherine Plymley’s Journals’, Ref: 1066/52 11<sup>th</sup> July 1798 to 15<sup>th</sup> July 1799 and 1066/74, 31<sup>st</sup> January 1808 to 8<sup>th</sup> June 1808, 1<sup>st</sup> March.

<sup>1053</sup> Shropshire Archives, Corbett of Longnor Collection, ‘Katherine Plymley’s Journals’, Ref: 1066/35, 36, 38, 52; 1066/52 11<sup>th</sup> July 1798 to 15<sup>th</sup> July 1799 and 1066/64, 14<sup>th</sup> April 1805 to 23<sup>rd</sup> July 1805.

<sup>1054</sup> Shropshire Archives, Corbett of Longnor Collection, ‘Katherine Plymley’s Journals’, Ref: 1066/78, 19<sup>th</sup> June 1809 to 17<sup>th</sup> August 1809.

<sup>1055</sup> Shropshire Archives, Corbett of Longnor Collection, ‘Katherine Plymley’s Journals’, Ref: 1066/67, 9<sup>th</sup> December 1805 to 14<sup>th</sup> July 1806.

<sup>1056</sup> Shropshire Archives, Corbett of Longnor Collection, ‘Katherine Plymley’s Journals’, Ref: 1066/68, 14<sup>th</sup> July 1806 to 31<sup>st</sup> October 1806.

mutually stimulating as he moved Katherine to comment that ‘his conversation is intelligent & he expresses himself with much clearness.’<sup>1057</sup>

In the circumstances of Plymley’s wide-ranging activities, including his roles as a prominent churchman and justice of the peace, the subject of the dinner-time conversations would frequently have been theological or socially-related, rather than cultural in content. Plymley had an extensive list of friends and associates and the opportunity to participate in the dissemination of knowledge on a cultural basis was embraced through social intercourse. Social issues aside, the Plymley group opened a window on the emergence of cultural science in the Shropshire region.

## **6.8 Conclusion- A fascination with natural philosophy**

John Desaguliers claimed in the preface to *A Course of Experimental Philosophy*: ‘a great many persons get a considerable knowledge of natural philosophy by way of amusement: and some are well pleased with what they learn that way as to be induced to study Mathematicks (sic), by which they at last become eminent philosophers.’<sup>1058</sup> It seems clear that the distinction between science and entertainment was recognised by participants and what for one person represented the means of personal advancement for another was an entertaining diversion. The cultural interest in science was for a number of Shropshire industrialists, sometimes peripheral but supplementary to their business interests: men such as William Reynolds and William Anstice with mining and ironmaking concerns engaged in chemical experimentation and geological enquiry. But what emerges is that during the late eighteenth and early-nineteenth-centuries there were Shropshire men and women who saw the benefit accruing from the acquisition of knowledge for reasons other than economic reward. In most

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<sup>1057</sup> Shropshire Archives, Corbett of Longnor Collection, ‘Katherine Plymley’s Journals,’ Ref: 1066/79, 17<sup>th</sup> August 1809 to 29<sup>th</sup> November 1809.

<sup>1058</sup> Desaguliers, J. T., *A course of experimental philosophy* (London, 3<sup>rd</sup> ed, 1763), p. viii.

cases they were not advancing the sum total of knowledge: in many instances they shared the knowledge they acquired for the interest and benefit of others. There were also those who recognised the need to extend the opportunity to the less fortunate members of society and in doing so advance the intellectual condition of society as a whole. Evidence presented in this chapter endorses from a cultural perspective, the philosophy espoused by Humphrey Davy that science functioned as a catalyst to social improvement.<sup>1059</sup>

The nature of contemporary association and intellectual communities has featured as a central theme within the thesis. Cultural contacts extended beyond the geographical county boundaries and were exercised, by those individuals who have formed the focus of this chapter, through correspondence, personal contacts and membership of organisations directed to the study and promotion of scientific subjects. Much of the epistolary testimony originates from the nineteenth century rather than the earlier period and, given the subject-related examples provided in the earlier substantive chapters, is possibly reflective of the local extant record than any phased development of the embracing of the ‘Republic of Letters’ by Shropshire men and women. The incidence of local cultural organisations of relevance to this study was generally of late origination although geographically broader-based formal associations, such as the Geological Society, were being founded much earlier. Such a profile may be indicative of a change in the momentum and dynamics of progression towards revised cultural paradigms. Multiple residency was enjoyed by many members of the local social elite affording opportunities for greater association: Members of Parliament lived in London when the House was sitting, as did those members of the social elite with second homes in the capital; some spent the social season in resorts such as Bath or Malvern and to itinerant lecturers like Benjamin Martin, James Ferguson and John Warltire, places such as Bath

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<sup>1059</sup> Davy, J., *The collected works of Sir Humphrey Davy, Bart.*, 9 vols. (London, 1839), cited in Berman, M, *Social change and scientific organisation: The Royal Institution, 1799-1844* (London, 1978), p. 60.

presented great opportunity to engage residents in the lectures upon philosophical subjects that they proffered.<sup>1060</sup> The activities of the itinerant lecturers brought audiences into direct contact with experimental philosophy, a process seen by Joseph Priestley as a stimulus to the spread of enlightenment.<sup>1061</sup>

The expression of enlightened ideals and desire to improve self and society through cultural endeavour reaffirms the view of earlier substantive chapters that developmental patterns were not restricted to the consequences of the county and region's economic history. In examining the exemplifications of contemporary cultural activity engaged upon within Shropshire, attention has been drawn to the multi-disciplinary involvement of individuals in the cause of improvement. For example, Reynolds as an innovative industrialist, a chemist and geologist; the progressive parliamentarian and landowner Slaney who sought to advance the situation of the poor and working classes but addressed a passion for botany and natural history; and the doctor Thomas Dugard, a chemist, geologist and natural historian, all display a commitment to advancement as a principle. Much of the evidence of enlightened and improving activity set out in this chapter arises well into the nineteenth-century and challenges the perception of an enlightenment that existed within the confines of the eighteenth. Alternatively that may arise from the interpretation of the evidence.

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<sup>1060</sup> Henderson, E., *Life of James Ferguson FRS, in a brief autobiographical account and further extended memoir* (London, 1867), pp. 272 and 408.

<sup>1061</sup> Bruton, R. N., *An examination of the extent to which scientific lecturers were contributing to the dissemination of knowledge in the mid-eighteenth-century West Midlands* (2009), unpublished MA dissertation (University of Birmingham, 2009); Golinski, J., *Science and public culture: chemistry and enlightenment in Britain, 1760-1820* (Cambridge, 1992), p. 92.

## Chapter 7: A Shropshire Enlightenment?

### 7.1 Introduction

Writing in 1771, the Unitarian chemist, Joseph Priestley considered that, ‘in spite of all of the fetters we can lay upon the human mind, notwithstanding all possible discouragements in the way of enquiry, knowledge of all kinds...will increase.’<sup>1062</sup> Beyond the political sphere it was the pursuit and application of knowledge, intended for the betterment of society and the individual that largely defined the eighteenth and early nineteenth-centuries in England. The principal focus of this study has been upon the form and presentation of intellectual activity associated with knowledge acquisition and dissemination in the second half of the eighteenth and early nineteenth-centuries in the county of Shropshire. Much of the previous academic attention within this field of enquiry upon the west midlands region has been directed towards the developing industrial towns, not least because of the picture painted by the emergence of the Industrial Revolution, of innovation and economic growth.<sup>1063</sup> It has also been conditioned in the last thirty years by explorations of an English form of Enlightenment and its utilitarian characteristics.<sup>1064</sup>

To a degree this thesis follows in that vein, in the light of the importance of Shropshire as a crucial component in the process of industrialisation; the East Shropshire Coalfield, for a time, representing a nodal point in the dissemination of knowledge. Where it deviates is in the recognition that despite its industrial credentials, the county and much of its economic

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<sup>1062</sup> Priestley, J., *An Essay on the First Principles of Government*, 2<sup>nd</sup> ed. (London, 1771), p. 253.

<sup>1063</sup> Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009); Money, J., *Experience and identity: Birmingham and the West Midlands, 1760-1800* (Manchester, 1977); Musson, A.E., *Science, technology and economic growth in the eighteenth century* (London, 1972); Inkster, I., *Scientific Culture and Urbanisation in Industrialising Britain*, (Aldershot, 1997); Inkster, I. and Morrell, J., (eds.), *Metropolis and province: science in British culture, 1780- 1850* (London, 1983); Schofield, R. E., *The Lunar Society of Birmingham: a social history of provincial science and industry in eighteenth-century England* (Oxford, 1963); Uglow, J., *The Lunar Men: The friends who made the future: 1730-1810* (London, 2002).

<sup>1064</sup> Kirk, L., 'The Matter of Enlightenment,' *The Historical Journal*, Vol 43, No 4 (Dec. 2000), 1129-1143; Mokyr, J., *The gifts of Athena* (Princeton, 2002); Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009); Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000); Porter, R., and Teich, M. (eds.), *The Enlightenment in National Context* (Cambridge, 1981).

catchment remained essentially rural. The thesis therefore explores contemporary knowledge acquisition and dissemination both within and beyond the industrial environment: seeking to place it within its contemporary setting. In doing so it acknowledges that cultural change, in this instance afforded by the development and diffusion of knowledge, is rarely initiated by a single cause, whether this is Enlightenment or industrialisation.

The structure of this concluding chapter brings together in summary form, the outcomes arising from the conduct of the study: in Section 7.2 it draws together the arguments made and the observations recorded in the substantive chapters. In doing so it addresses the research questions and those lines of enquiry set out in Section 1.2 of Chapter 1. The organisation of Section 7.2 is based upon continuing themes that are present within Chapters 3 to 6: innovation and adaptation; acquisition and dissemination of knowledge, with particular reference to intellectual communities, printed influences, instruction and emulation. Section 7.3 touches upon aspects of social concern that stray into the defined scope of this study. They relate largely to the social drivers of infrastructure improvement. Section 7.4 sets out the merits of the study in terms of content and methodology and the contribution that it has made to understanding regional Enlightenments and intellectual networks. It also incorporates opportunities for further research. In conclusion, Section 7.5. draws together observations on the competing cultural concepts of Enlightenment and Improvement.

## **7.2 The study outcomes**

Employing four substantive chapters and case studies, the thesis has considered facets of improvement and enlightenment: intellectual activity in contemporary Shropshire is explored; innovation, the adoption of new utilitarian processes, the acquisition and sharing of knowledge and the importance of association are examined in different contexts. In doing so

the form of intellectual activity in contemporary Shropshire is discerned.<sup>1065</sup> Examples of those aspects of social awareness that fell outside the ambit of the study have been identified, together with the extent to which they may have reflected attitudes in an Enlightenment or improving sense. The published history of Shropshire has been dominated by the role it played in industrialisation and the thematic chapters broaden the perspective of that history. It determines that enlightened activity and ‘The Spirit of Improvement’ were alive amongst Salopians and that they were not confined to industrialisation.<sup>1066</sup> The examples presented of the application of knowledge, add to the understanding of how aspirations for the enhancement of society were addressed. Consequently they inform the debate on the existence of regional Enlightenment.<sup>1067</sup>

### **7.2.1 Innovation and adaptation**

Innovation, as a visible depiction of intellectual activity, is acknowledged within Chapter 4 amongst the technical advances initiated by Shropshire ironmasters and engineers. Abraham Darby II and his son, Abraham III, William Reynolds and John Wilkinson are amongst the stellar names in this particular field of endeavour, advancing knowledge of the characteristics and uses of iron. But lesser-known individuals have been added to the equation: William Hazeldine, referred to by Telford as ‘Merlin Hazeldine,’ provided the iron for many of Telford’s major constructions, as well as for the Ditherington Flax Mill, but whose design contribution to the innovative utilisation of iron in these projects is undocumented; John Rastrick, an engineer who produced designs in his own right but worked with steam engine and locomotive designers who were attracted to Ketley and Coalbrookdale at the end of the eighteenth-century; Lord Dundonald brought his ideas for the distillation of tar to Shropshire

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<sup>1065</sup> See Chapter 1 Section 1.2 , p.13 re identification of lines of enquiry and questions undertaken.

<sup>1066</sup> See Chapter 1 Section 1.2 , p.14 re identification of lines of enquiry and questions undertaken.

<sup>1067</sup> See Chapter 1 Section 1.2 , p.14 re identification of lines of enquiry and questions undertaken.

and as a chemist was eager to promote his scheme for an integrated chemical works at Coalport for the production of alkali.

During this period Shropshire was synonymous with iron and although the employment of innovation within the county went beyond industrial production, the illustration of iron's application reflects upon the transferability of knowledge between sectors.<sup>1068</sup> The design and construction of the iconic Iron Bridge and the 'fireproof' Ditherington Flax Mill were examples, as was Pontcysyllte Aqueduct. Infrastructure improvement in general in the county bore witness to examples of innovation. The application of primitive rail-ways for the transportation of materials and product had been employed in Shropshire from the early seventeenth-century and with the growth of iron production from the middle of the eighteenth-century, the extension of their application and the utilisation of iron in rails was undertaken by Richard Reynolds and John Wilkinson in particular. In 1813 James Loch promoted their extended use to join with unconnected canals in order to advance the transport of goods to wider markets.

Innovation overcame technical blockages or, in the case of the canal system, topographical obstacles. The carriage of a trough of water 126 feet in the air as at Pontcysyllte, or the amelioration of severe undulation in the terrain through which the Shropshire and Shrewsbury canals passed, were resolved through the application of new techniques, a better understanding of the characteristics of materials employed or the adaption of established principles. But innovation is frequently the marrying of perceived need with ability and knowledge and the flow of innovation is inevitably variable. Examples of innovation of a utilitarian nature appear to have been resource or even demand-constrained in Shropshire, indicating a lack of identifiable need; the perception of need to change; or of capability to

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<sup>1068</sup> See Chapter 1 Section 1.2 , p.14 re identification of lines of enquiry and questions undertaken.

innovate at particular moments. Hayman drew attention to the apparent paucity of new techniques originating within the county's wrought-iron operations after the first decade of the nineteenth-century.<sup>1069</sup> It seems to have been a situation replicated in other fields of utilitarian endeavour. In structural engineering, Charles Bage carried out pioneering full-scale testing on beams and roof trusses in the early years of the century and iron roofing frames were incorporated into the Benyon and Bage partnership's new flax mills at Leeds (1803) and Castlefields, Shrewsbury (1804).<sup>1070</sup> Beyond that early period of the century there is little identifiable as innovation emerging from industrial quarters of the county.

But employment of innovation is not the sole yardstick for measurement of improvement aimed at social enhancement; frequently adoption and adaptation bore the imprint of creativity as exemplified in the incorporation by Reynolds of inclined planes on the Ketley and Shropshire Canals and the adoption of knowledge imparted by Strutt's correspondence with Bage. Local conditions were often determining factors in the application of pre-existing techniques and ideas. Such was the case in agriculture.<sup>1071</sup> The variety of weather, soil and topographical conditions within Shropshire and the border areas not only determined the suitability of particular crops, methods and practices but undoubtedly conditioned the unevenness in adoption of improving attitudes.<sup>1072</sup> As with other areas of activity addressed within the thesis, the establishment of reasons and motivation for an individual to become engaged in agricultural improvement are frequently complex and often difficult to determine, as noted in Chapter 5.<sup>1073</sup> The existence of improving activity is less difficult to discern. In exploring the role of 'agents of improvement' research was conducted into the involvement of

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<sup>1069</sup> Hayman, R., *The Shropshire Wrought-iron industry c1600-1900*, PhD thesis, University of Birmingham, 2003, p. 8.

<sup>1070</sup> Chapter 4 Case study.

<sup>1071</sup> See Chapter 5.

<sup>1072</sup> See Chapter 1 Section 1.2, p.14 re identification of lines of enquiry and questions undertaken.

<sup>1073</sup> See Chapter 5, Conclusion.

landowners with estate improvement.<sup>1074</sup> It also examined the extent to which estate stewards determined the need or nature of change or expedited the instructions of owners. In general the study did not identify previously unknown agricultural improvers of consequence, but set the state of Shropshire agriculture in the context of developing knowledge and cultural paradigms. In the main it was ‘adoption’ rather than ‘innovation’ that prevailed, albeit fitfully, in Shropshire agriculture. The trialling and establishment of the suitability of particular crops or livestock breeds for the required location was rigorously employed by those Shropshire agriculturalists who saw themselves as ‘improvers.’ However when the adoption of new techniques and produce are initiated as part of a structured programme of change, incorporating modification of property tenure, reorganisation of farm layouts and construction of new roads, extensive drainage and the promotion of emulation amongst tenant farmers, as Loch accomplished in respect of the Marquis of Stafford’s English estates, it may warrant being considered as innovation.<sup>1075</sup>

### **7.2.2 Acquisition and dissemination of knowledge**

Contemporary perceptions of the importance of knowledge to the improvement of society precipitated a change in cultural paradigms of the eighteenth-century.<sup>1076</sup> For James Loch recognition of the power for social enhancement afforded by the acquisition of knowledge was undoubtedly influenced by his mentor at Glasgow University, Dugald Stewart. In addition to its employment by him upon the Stafford estates, it found further expression beyond Shropshire, on other landed properties, through public office and parliamentary service.<sup>1077</sup> For William Reynolds, intellectual interests drew him to mechanical and civil engineering, infrastructure development, metallurgy, geology and chemistry and he was

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<sup>1074</sup> See Chapter 1 Section 1.2 , p.14 re identification of lines of enquiry and questions undertaken.

<sup>1075</sup> See Chapter 1 Section 1. 2, p.14 re identification of lines of enquiry and questions undertaken.

<sup>1076</sup> See Chapter 1 Section 1. 2, p.14 re identification of lines of enquiry and questions undertaken.

<sup>1077</sup> Richards, E., ‘Loch, James (1780–1855)’, *Oxford Dictionary of National Biography*, Oxford University Press, 2004  
<http://www.oxforddnb.com/view/article/16883>

driven by the desire to heighten understanding through empirical means.<sup>1078</sup> The civil engineer, Thomas Telford was undoubtedly stimulated by challenge. Paxton refers to his ‘restless ambition’ and he strove to address those challenges through knowledge acquisition.<sup>1079</sup> The influence of acquired knowledge upon social improvement is less apparent but nevertheless finds support amongst contemporary Salopians. Matthew Davidson forcefully promoted the case for the ‘acquisition of useful knowledge’ to his son, concluding, ‘this is a fund of happiness which the ignorant man can never taste,...I look upon ignorance as criminal, where there has been any opportunity for information.’<sup>1080</sup> Katherine Plymley and Louisa Kenyon took to the study of science, not merely for self-improvement but to further the social opportunities of the children in their educational care.<sup>1081</sup> As with landed improvers who planted thousands of trees for the benefit of later generations, such engagement represents a commission of faith or hope in the future given the uncertainty of its outcome: one being minded of Mary Kenyon’s death at the age of fifteen.<sup>1082</sup> It reinforces Kant’s belief that it was commitment of the individual to an enlightened ideal that was important, not necessarily the measurable consequences of the actions involved.<sup>1083</sup> The thesis nevertheless demonstrates how aspects of enlightened activity in Shropshire were conditioned by acquisition and transference of knowledge.<sup>1084</sup>

### 7.2.2.1 Intellectual communities and networks

The manner of the transmission of knowledge, however, gives a clearer indication of the prevailing dynamic associated with the process. Modern commentators upon the period have

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<sup>1078</sup> Witness the references to his laboratory at Bank House (Chapter 4, p.117, Chapter 6, p. 243) and the Ketley tests on iron (Chapter 3, p. 63)

<sup>1079</sup> Paxton, Roland, ‘Telford, Thomas (1757–1834)’, *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edn, Jan 2008 [<http://www.oxforddnb.com/view/article/27107>]

<sup>1080</sup> See Chapter 6 above; Ironbridge Gorge Museum Library, Ref: DMD8-Acc No 1992.14918, *Matthew Davidson correspondence; copy letter book 1795-1818*, Davidson to Thomas Davidson- 21st Feb 1813; Matthew Davidson was born in Eskdale, Scotland, but for a period resided and worked within Shropshire. In the context of this study he is deemed to be an honorary Salopian.

<sup>1081</sup> See Chapter 6

<sup>1082</sup> See Chapter 6

<sup>1083</sup> Kant, Emmanuel, ‘*Was ist Aufklärung?*’

<sup>1084</sup> See Chapter 1 Section 1.2 , p.14 re identification of lines of enquiry and questions undertaken.

attested to the importance of association and communication in the formulation of economic and social improvement.<sup>1085</sup> What emerges from this and other studies focussing upon regional distinctiveness is the variation of prevailing local forms of association. Unlike some urban or county towns, Shropshire had no philosophical society until well into the nineteenth-century, whereas Manchester (from 1781), Newcastle (1793) and Bath (1779) did.<sup>1086</sup> Derby had philosophical groups in the 1760s and 1770s, although the most notable incarnation was Erasmus Darwin's Derby Philosophical Society, founded in 1784.<sup>1087</sup> Others, such as Leeds (1821) and Sheffield (1822) were formed when local urbanisation reached a particular economic and social level.<sup>1088</sup> Shropshire was therefore late in the establishment of a philosophical society. Records of eighteenth-century associations and functional societies in the county are also scarce, although Peter Clark declares that was not an unusual state of affairs prior to the 1790s.<sup>1089</sup> From the turn of the nineteenth-century the establishment of formal organisations becomes apparent in Shropshire. A number of agricultural societies were created. At Shifnal in 1800 the promoters' expressed aim was to 'excite a Spirit of Improvement' amongst farmers and landowners.<sup>1090</sup> Two natural history societies were established in the 1830s, in Shrewsbury and Ludlow and papers on a range of subjects were delivered to the members. Similarly, opportunities arose through the Mechanics' Institutions where self-improvement on both economic and cultural grounds was promoted for the particular benefit of artisans and craftsmen.

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<sup>1085</sup> Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850* (Manchester, 2009); Jones, P.M., *Industrial Enlightenment: science, technology and culture in Birmingham and the West Midlands, 1760-1820* (Manchester, 2009); Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009).

<sup>1086</sup> The earliest-dated reference to a philosophical society in Shropshire identified in the course of this study is in a notebook containing a lecture on natural history by John Dovaston (1782-1854), naturalist and poet to the Philosophical Society in Shrewsbury, 24<sup>th</sup> Oct 1830, University of Birmingham Cadbury Library, Ref: MS737, 'Works of John Dovaston, 1816-30.'

<sup>1087</sup> Elliott, P. A., *The Derby Philosophers: science and culture in British Urban Society, 1700-1850* (Manchester, 2009).

<sup>1088</sup> Inkster, I., 'The development of a scientific community in Sheffield, 1790-1850,' in *Scientific Culture and Urbanisation in Industrialising Britain*, Ashgate, Aldershot, 1997, pp. 99-131

<sup>1089</sup> Clark, P., *British clubs and societies, 1580-1800: the origins of an associational world*, (Oxford, 2001), p. 9.

<sup>1090</sup> *Aris's Birmingham Gazette*, 3<sup>rd</sup> March 1800.

But informal intellectual communion was more important in the dissemination of knowledge than that arising through formally organised clubs or societies.<sup>1091</sup> The thesis has demonstrated that such association played an important part in both utilitarian and cultural science activities for Salopians. The creation of informal intellectual communities around Ketley and Coalbrookdale and amongst the mechanical and civil engineers within the region had a direct influence upon the inception of innovation; on the absorption and application of useful knowledge and its transmission. Visitors were eager to view the results or participate in the process of improvement and discovery. Trevithick, Hornblower, Rastrick, Heslop, Glazebrook, Sadler were all steam engineers who were drawn to the ‘centre of engineering excellence’ found in East Shropshire. They joined with the local ironmasters, Abraham Darby III and William and Joseph Reynolds to commit their own contribution to the reservoir of engineering knowledge. Samuel More, Secretary of the Society of Arts and considered a ‘nodal point’ for knowledge dissemination himself, visited on a number of occasions, as did the Italian scientist Allesandro Volta. The world’s first multi-storey iron-framed building owed much to the connections between Bage, Strutt and others. In Chapter 3 the effectiveness of the group assembled for the design and construction of the Ellesmere Canal and its structures gives testimony to the manner of innovation that arose from the combination of talented individuals. Barrie Trinder pointed out that Pontcysyllte did not stimulate a rush to construct aqueducts but that is not an indication of its historical importance. It established iron as a structural material of the future and provoked the creation of techniques in civil engineering that informed subsequent and larger construction projects.<sup>1092</sup>

In the commercial environment such associations were not always a matter of choice: they were frequently obligatory. On the Ellesmere Canal, collaboration between Telford and

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<sup>1091</sup> See Chapter 1 Section 1.2 , pp.13-14 re identification of lines of enquiry and questions undertaken.

<sup>1092</sup> See Chapter 1 Section 1.2 , p.13 re identification of lines of enquiry and questions undertaken.

Jessop was a contractual commitment, as it was between Telford and Reynolds on the Shrewsbury Canal. Loch established a team of able agents with whom he was able to confer and upon whom he could rely, in the implementation of what has to be considered an innovative approach to land management. The contact between Bage and Strutt was initiated with a specific purpose in mind but evolved into a forum for regular discussion and knowledge exchange. The examples considered demonstrate a contemporary belief in the strength afforded by collaboration and for a time in Shropshire, innovation arose from such association.<sup>1093</sup> Communion enjoyed through the adoption of natural philosophy as a cultural expression, was different. Chapter 6 demonstrates that interests were evinced in chemical experimentation, geology, botany and natural history and the manner of their pursuit. Intellectual communities are therefore visibly employed for both utilitarian purposes and in respect of the pursuit of self-improvement. The thesis has demonstrated that the establishment of such relationships furthered personal knowledge and the advancement of science.<sup>1094</sup>

Katherine Plymley's diaries afforded the opportunity to witness the coming together in a social environment, of individuals with a diversity of skills or interests. Many had connections with the Church or magistracy. Some were old friends, some were new acquaintances with similar interests, but it was never a cohesive group such as the Lunar Society. On occasions she gave descriptions of visitors, their characters, occupations or personal pursuits, but less frequently did she convey the nature of topics of discussion or debate. However, in the cases of Joseph Babington and Robert Townson, for example, she is more explicit. The mutual interest of guests and hosts in aspects of natural history or mineralogy is discussed.<sup>1095</sup> A constant challenge in the study of networks lies in determining whether contact was effected in those circumstances where the opportunity for meeting arose

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<sup>1093</sup> See Chapter 1 Section 1.2 , p.13 re declaration of lines of enquiry and questions undertaken.

<sup>1094</sup> See Chapter 1 Section 1.2 , p.13 re declaration of lines of enquiry and questions undertaken.

<sup>1095</sup> See Chapter 6

and what outcome, in terms of knowledge exchange, resulted from such meetings. In such circumstances the commentator is left making subjective judgements or merely offering the prospect of association. Alternative sources of verification, where they exist, may endorse such opinions. That is the approach adopted in this study. It places uncertainty therefore over any enlightened outcomes arising from much of the dining at the Plymleys.

A parallel situation exists concerning the possession of formative texts: that is possession does not attest to them being read by their owner or that conditioning of opinions or actions arose from that ownership. For example the library of the magistrate Rowland Hunt contained volumes on agriculture and science but although he displayed progressive attitudes to social improvement, there is no indication of any abiding interest in cultural or utilitarian science, or that he took positive strides to improve the cultivation of his estate. As has been demonstrated in a number of the chapters, Hunt was prominent amongst local civic leaders in the pursuit of social improvement and his progressive beliefs found different outlets to those of the engineers and agricultural improvers.

Throughout the study, correspondence has been shown to have sustained contemporary intellectual networks and to further the exchange of knowledge.<sup>1096</sup> Its significance to the research lies in its ability to illuminate relationships. Familial, business and social bonds are all explored in extant or edited correspondence. The letters produce a picture of relationships, the nature or extent of which had not always previously been apparent. They have also drawn attention to the intellectual interests of correspondents, all of which has enhanced the scope and direction of the research. *The letterbook of Richard Crawshay*, the Cyfarthfa ironmaster, shows the constructive relationship between ironmasters who might otherwise be considered to be competitors, particularly his letters to John Wilkinson and William Reynolds. It

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<sup>1096</sup> See Chapter 1 Section 1.2 , p.13 re declaration of lines of enquiry and questions undertaken.

provides information on visits and travels undertaken and opinions sought from his friends. He emerges as part of the wider network occupied by some of the Shropshire ironmasters and his letters and activities demonstrated aspects of the securing of useful knowledge and its dispersal. The correspondence between Charles Bage and William Strutt also provided insight into the nature of contemporary acquisition and transmission of technical knowledge, albeit from one side of the conversation. Detail of experimentation is disclosed and epistolary discussion takes place over the merits of particular hypotheses. It portrays the evolving nature of the relationship, with the growing confidence of Bage in his technical ability, coming to the fore. This epistolary conversation between Bage and Strutt was instrumental in the construction of the world's first multi-storey, iron-framed building at Ditherington and the development by Bage of a hypothesis on the measurability of the load-bearing capabilities of iron that, according to Skempton, remained credible until well into the nineteenth-century.<sup>1097</sup> Letters amongst the network of engineers on the Ellesmere Canal construction were utilised to good effect in the expression of opinion and in the furtherance of knowledge in an emerging science.<sup>1098</sup> In Chapter 5 Loch's extensive use of correspondence in the search for information and its subsequent dissemination sustains the epistolary network that he inhabits.<sup>1099</sup>

The contribution of intellectual communities associated with knowledge generation and transmission has been demonstrated. They were determinative influences in industrial processes and innovation; they were instrumental in defining the means of enhancement of infrastructure; they precipitated the transferability of methods and materials between fields of endeavour; they were forums for the pursuit of self-improvement; for the realisation of Enlightenment ideals and the expression of the spirit of improvement. That in the Shropshire

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<sup>1097</sup> Shropshire Archives, Ref: 6001/2657/1-38, Letters from Charles Bage to William Strutt; Skempton, A. W. and Johnson, H. R., 'The first iron frames,' *Architectural Review*, 1962, p. 182.

<sup>1098</sup> Chapter 3 case study

<sup>1099</sup> Chapter 5 case study

region they were not as prominent as in other settings, particularly urban locations, reaffirms the nature of variability occasioned by the contemporary drive for improvement and testifies to the continuing importance of local studies in the rationalisation of English Enlightenment history. One cannot dismiss the possibility, however, that the inadequacy of extant evidence distorts the picture.

### **7.2.2.2 Printed influences, instruction and emulation**

Shropshire inhabitants availed themselves of the opportunity to access knowledge from a variety of sources. The eighteenth-century witnessed a dramatic increase in the production of printed material and a healthy print industry existed for Salopians to acquire books, pamphlets and journals.<sup>1100</sup> The ownership of philosophical texts and those associated with science and agriculture have been identified in probate inventories but they are relatively few in number in Shropshire Archives. The minutes of the Mechanics Institution in Shrewsbury record details of orders for books to be placed in its library and together with the inventories described, give an indication of what people owned or had access to. Private loans further widened the readership of texts. Matthew Davidson's son Tom had access to Thomas Telford's personal library and the father reminded his son to apply care to his treatment of the contents and as a consequence would never be at want for books: 'Indeed generous minds are much gratified by communicating knowledge in this way.'<sup>1101</sup> Libraries were becoming established not only through societies but also for public access. The library of the Shrewsbury School was open to the people of the town and by 1767 had some 5,000 books.<sup>1102</sup> However the lack of contemporary catalogues of library holdings prevents an appreciation of the diversity of subject matter held and how widely natural philosophy and agricultural improvement were

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<sup>1100</sup> In particular see Chapter 6, pp. 17-19.

<sup>1101</sup> Ironbridge Gorge Museum Library, Ref: DMD8-Acc No 1992.14918, *Matthew Davidson correspondence; copy letter book 1795-1818*, Davidson to Thomas Davidson- 30<sup>th</sup> April 1809.

<sup>1102</sup> McInnes, A., 'The emergence of a leisure town: Shrewsbury, 1660-1760,' *Past and Present*, 120 (Aug 1988), p. 70.

represented. The examples of ownership represent a small sample upon which to make definitive statements but national trends and the influence of market forces which sustained the recorded level of local retail print outlets, give support to the belief that Shropshire inhabitants freely employed printed material to indulge ambitions for improvement: as do occasional references within personal diaries.<sup>1103</sup> It remains an area of study with the potential for future research that will enhance the conclusions drawn by this thesis.

The itinerant lecturers brought natural philosophy into the public sphere in the provinces, a process considered by Priestley to provide a stimulus to the spread of enlightenment.<sup>1104</sup> The Royal Society's chief demonstrator, John Desaguliers maintained that better understanding of things was afforded by the application of the senses than by reading alone and the lecturers were prominent in the process of transmission of knowledge: they were creating what were often locally-specific forums of knowledge exchange. Essentially the lecturers were selling themselves. They were selling their abilities to transmit new and exciting information about the world in which they lived, to an audience willing to pay for it and in some, were stimulating a 'spirit of improvement.' The presence of women at lectures is an important sign of cultural change. It is a visible reflection of their willingness or determination to participate in the public sphere to a greater degree and may be seen as a positive manifestation of that spirit. There is no evidence of the lecturers operating in what is now referred to as the West Midlands before the 1740s and the first documented record of an appearance in Shropshire is 1748. The scope of their appeal to the local population is however, unclear, although a continuing presence is identifiable during the period of this study.<sup>1105</sup> More extensive studies

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<sup>1103</sup> University of Birmingham Cadbury Library, Ref: RAS/1/3, 'The journals of R. A. Slaney;' Shropshire Archives, Ref: 6003/1-9, 'R. A. Slaney Diaries.'

<sup>1104</sup> Golinski, J., *Science as public culture: chemistry and enlightenment in Britain, 1760-1820* (Cambridge, 1992), p. 96.

<sup>1105</sup> See Chapter 6.

of local newspapers and journals are needed to establish the extent and frequency of that presence.

Emulation was a major factor in the process of improvement. It was prompted by an increasing awareness of opportunity, an expanding appreciation of the rationality of nature and was driven by cultural paradigms and fashionable determinations.<sup>1106</sup> Boud prefers to attribute emulation to identification of personal deficiencies and enhancement brought about by a sense of rivalry but this seems an inadequate generalisation in the light of evidence presented in this study.<sup>1107</sup> Loch promoted emulation amongst his under-agents and tenants. It was stimulated by membership of societies and intellectual communities; in agriculture by attendance at shows, at demesne farms; and through farm and estate visits. White's evidence to the Parliamentary Select Committee on Agriculture confirmed a widening spirit of emulation amongst local farmers in Shropshire in 1833.<sup>1108</sup> It was an issue of social relevance for the propertied classes. In an agricultural context, contemporary references pointed to 'improvement' being an issue of fashion or social approbation.<sup>1109</sup> The *Farmer's Magazine* in 1807 declared that a gentleman must be able to converse on agriculture if he didn't wish to look foolish. The influence of the king, George III, has also been credited with heightened interest in agricultural improvement.<sup>1110</sup> Did agricultural improvement in Shropshire therefore reflect prevailing social and cultural issues?<sup>1111</sup> The study argues that for many, fashion, financial necessity or desire and social imperatives influenced the course of improvement. Those factors were not restricted to agriculture, other aspects of improvement were

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<sup>1106</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009), p. 389.

<sup>1107</sup> Boud, R. C., 'Scottish Agricultural Improvement Societies, 1723-1835,' *Review of Scottish Culture* (Edinburgh, 1984), p. 80.

<sup>1108</sup> House of Commons Parliamentary Papers, 'Report from the Select Committee on Agriculture,' 1833, Evidence of Richard White, 14th May 1833, <http://parlipapers.chadwyck.co.uk>, q. 473. See Chapter 5.

<sup>1109</sup> For example, *The Farmer's Magazine, a periodical work exclusively devoted to Agriculture and Rural Affairs*, 8, 1807, p. 314.

<sup>1110</sup> Briggs, A., *The Age of Improvement 1783-1867* (London, 1959, Folio edition 1999), p.35; Horn, P., 'The contribution of the propagandist to Eighteenth-century agricultural improvement,' *The Historical Journal*, 25,2 (1982), p. 317.

<sup>1111</sup> See Chapter 1 Section 1.2 , p.14 re declaration of lines of enquiry and questions undertaken.

conditioned by the same influences. In many of these cases the emulation of others is apparent.

### 7.3 Social Imperatives

Social imperatives that stimulated concerns and reactions amongst Shropshire's population are largely beyond the scope of this study, but they incorporated welfare of the poor and the abolition of the slave trade. However the extension of concern into other areas materialised in expressions of the culture of improvement, particularly in the case of infrastructure. The Shrewsbury Canal, which opened in 1797, was founded on the aim of securing a dependable and cheaper supply of coal for Shrewsbury. It was an action directed towards the benefit of the population as a whole rather than an enterprise solely favouring commercial entities and investors. Similar justifications were espoused in respect of the Ellesmere Canal and its conjoined Montgomeryshire Canal. Telford commented that the most significant benefits arising from the Ellesmere Canal would be to the agriculture of adjoining areas. The Act enabling the construction of the Montgomeryshire Canal declared that with expectation of income from tolls being insufficient to finance construction of the canal, the subscribers were landed property owners in the locale whose declared aims were 'the extension of agriculture ...with the consequent advantage to the public.' However presumptions of wide-spread altruism have to be tempered with considerations of the events surrounding the oversubscription of the public share offer in the Ellesmere Canal and 'the excessive intrusion of too ardent speculation.'<sup>1112</sup> Hunt was led to remind auditors at the opening of Pontcysyllte that immediate profit should not be their principal concern but rather the interests of

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<sup>1112</sup> Telford, T., in Plymley, J., *A General view of the agriculture of Shropshire: with observations drawn up for the consideration of the Board of Agriculture and internal improvement* (London, 1803), p. 302; Ironbridge Gorge Museum Library, Hunt, R. 'Report to the General assembly of the Ellesmere Canal Proprietors held at the Royal Oak Inn, Ellesmere on 27<sup>th</sup> day of November 1805 to which is annexed, The Oration, delivered at Pontcysyllte Aqueduct on its first opening, November 26 1805,' p. 19.

others.<sup>1113</sup> Details of formative investment in the Montgomeryshire Canal have not been located in order to test this intent but the issue of whether altruistic investment can be seen to substantiate enlightened pronouncements of improvement is challenging, as the record of original investment in the Shrewsbury Canal demonstrates.<sup>1114</sup>

In a number of instances, social awareness was illustrated by the attitude of innovators towards intellectual property rights. Abraham Darby II proclaimed he had no wish to patent his process of utilising coal instead of charcoal in founding iron, considering that knowledge of the process should be available to all. His nephew, William Reynolds, held similar views, disavowing the retention of secrets where the interests of humanity were concerned. As a consequence, steam-power engineers were attracted to Ketley and Coalbrookdale with their reputation for innovation, seeking to develop their own theories in engine technologies in that productive environment.<sup>1115</sup> The properties of iron, established as a result of load testing conducted at those ironworks, were freely disseminated. Bage claimed to have acquired the knowledge to assist his design of Ditherington Flax Mill directly from Joseph Reynolds; John Banks to have been requested to make the information ‘as public as possible for the advantage of others.’

Concern over the welfare of the lower orders found expression in the mid-1820s through the support of local gentlemen for Mechanics Institutions, which sought amelioration of the poor by means of the provision of educational opportunities. In an essay, Slaney cited Sumner’s treatise in which he argued that ignorance was the greatest obstacle to efforts to improve the condition of the poor and that they should be habituated into becoming ‘agents’ in their own

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<sup>1113</sup> See Chapter 3 case study

<sup>1114</sup> Chapter 3 p. 70.

<sup>1115</sup> See Chapter 4; Raistrick, A., *Dynasty of ironfounders* (London, 1953), p. 156; Trinder, B., ‘William Reynolds: Polymath- A biographical strand through the Industrial Revolution,’ *Industrial Archaeological Review*, XXX:1, (2008), p. 22 ;

betterment through the enhancement of intellectual capability.<sup>1116</sup> For Slaney 'the advantage derived from education is not confined to one time or place, it continues during a man's whole life; it influences all his actions; does not die with him; and may be considered as a lasting benefit to the human race.'<sup>1117</sup>

#### **7.4 Further Research**

During the course of this study further opportunities for research which extend those employed in the production of this thesis, have become apparent. In the context of civil engineering or major works, the relocation of craftsmen and artisans with an established or customary affiliation, from one contract to another, may be seen as a new form of labour organisation. It was a situation exemplified in Chapter 3 with the transfer of key personnel from the Ellesmere Canal construction to others undertaken by Telford.<sup>1118</sup> The transfer of bodies of men wholesale between jobs or locations would have afforded guarantees of the availability of appropriate skills and knowledge of the working practices demanded of the role and by the principal. Such practice augments the transfer of knowledge to the less well-informed. Hayman and Perez have both addressed the contribution of artisans to the transfer of useful-knowledge but very much in the context of workshop environments.<sup>1119</sup> The inclusion of craftsmen and technical professionals in the scenario described and its extension beyond the workshop offers further research potential into the manner in which labour organisation influenced contemporary economic growth.

A number of opportunities exist for further studies on agriculture within Shropshire. An under-utilised collection of estate papers of the Clive family offer the prospect of studying the

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<sup>1116</sup> Sumner, J. B., *A treatise on the records of the creation, and on the moral attributes of the creator; with particular reference to the Jewish history...*, Vol. II (London, 1818), p. 333.

<sup>1117</sup> Slaney, R. A., *Essay on the beneficial direction of rural expenditure* (London, 1824), p. 155.

<sup>1118</sup> Chapter 3, p.30.

<sup>1119</sup> Hayman, R., *The Shropshire Wrought-iron industry c1600-1900*, unpublished PhD thesis, University of Birmingham, 2003; Hilaire-Perez, L., 'Technology as a public culture in the eighteenth-century: the artisans' legacy,' in *History of science*, vol. 45 (April 2007), pp.137-154.

process of development of the estates of arguably the most prominent ‘improving’ landed family in the county and the influence of their principal estate agent, John Probert. Some agents were the originators of change, whilst others merely implemented the instructions of their owners. Some may be considered to be less than competent. A fuller study of the individual estates and the contribution of their respective agents will afford an appreciation of their contribution to improvement. On a smaller scale the identification of subscribers to the Shifnal Agricultural Society will offer insight into those farmers who were prepared to be imbued with the ‘spirit of improvement,’ as the promotional advertisements proclaimed, their social standing, the size of their farms and perhaps the nature of change they effected.

Improved understanding of contemporary enlightened activity and the opportunities afforded for self-improvement can be realised by a detailed study of the activities of the itinerant science lecturers who operated in the region throughout the period covered by this thesis.<sup>1120</sup> Analysis of the advertisements contained within the county’s local newspapers may give a clearer picture of the extent of their activity; the subjects they covered; the audiences they were targeting. A full study would involve the examination of in excess of 5,000 newspaper editions.

This thesis has highlighted the need for further studies on local manifestations of Enlightenment. The establishment of a body of work upon the subject will underline local variability in enlightened activity and expressions of the desire to improve. It will indicate the extent to which local economic and social structures influenced the emergence, uptake and character of improving behaviour; and identify the degree to which commonality of influence was reflected in the form of local manifestations of Enlightenment. A strength of the study and thesis lie in its structural organisation and the detailed analysis of primary sources. The

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<sup>1120</sup> See Chapter 6

utilisation of substantive chapters adds to the clarity of the presentation of each discrete subject whilst the incorporated case studies allow for greater depth of scrutiny of events and processes. Analysis also affords the opportunity to challenge perceived wisdom in a number of instances. The thesis offers an approach that can be utilised in other regional studies of the Enlightenment. It offers an examination of technological change and agricultural improvement in one particular locality. It utilises the epistolary record and personal testimony, by way of diaries and journals. The letters of Bage and Loch and the journals of Plymley and More cast light onto events of the eighteenth and early nineteenth-centuries, advancing contexts and the understanding of events and relationships. Throughout the thesis the importance of intellectual communities are to the fore. It emphasises the importance of the association of individuals in progressive actions; how knowledge flowed within and through those networks and was frequently enhanced, thereby adding to the reservoir of contemporary useful knowledge.

### **7.5 Improvement or Enlightenment?**

The existence of ‘improvement’ as a cultural form persisted from the sixteenth-century and it offers an alternative explanation for the heightened activity directed towards social and economic enhancement. Peter Borsay considers that it was a conditioning factor for Enlightenment in Britain and this thesis has offered an alternative hypothesis: that Enlightenment ideals stimulated the pre-existing cultural paradigm of ‘Improvement’ to new heights of intensity. Although the actions and convictions of some Salopians may exhibit enlightenment credentials do such declarations endorse the existence of a local Enlightenment?<sup>1121</sup> Joel Mokyr estimated that 10-15 percent of the population of contemporary Britain may have been influenced by Enlightenment thought, which based upon

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<sup>1121</sup> See Chapter 1 Section 1.2 , p.13 re declaration of lines of enquiry and questions undertaken.

1801 census returns, would represent between 15,000 and 25,000 Shropshire inhabitants.<sup>1122</sup> He claims that a small minority of persons effected major economic changes. Mokyr chooses, however, to set aside the contribution of the craftsmen, and some women, who pursued self-improvement or those who occasioned process enhancement and transferred knowledge through their mobility. In doing so they contributed in no small measure to the improvement of society. It seems that a true measure is based not on the magnitude of the change effected but on the commitment employed and has echoes of Kant. However, an accurate assessment of the numbers adhering to Enlightenment sentiments is impossible to establish. The best that can be hoped for is a considered overview based on identifiable evidence.

Thomas Munck argues that consideration of Enlightenment from national perspectives, or one that is reflective of different cultures, is problematic in that its formative philosophies eschewed ‘parochialism and insularity.’<sup>1123</sup> In Enlightenment terms, a national or regional identity does not necessitate ‘insularity,’ rather recognition of characteristics of often diverse manifestations of enlightenment behaviour, as has been exemplified in this thesis. The study has demonstrated that for a short period Shropshire was a nodal point for the dissemination of useful knowledge: empiricists and the curious, from Britain, Europe and America visited the county, some searching for knowledge and some to join with those actively engaged in its furtherance. Local studies have been a rich source of information on the form of regional Enlightenments: this one adds to the understanding of intellectual activity in the west midlands at a time of great innovation. Shropshire was on the geographical periphery of the region and despite having a formative influence on the region’s economic progress, its social, economic and cultural footprint differed from the burgeoning industrial towns. Accordingly the manifestation of enlightenment ideals or the ‘spirit of improvement’ are distinct and the

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<sup>1122</sup> Mokyr, J., *The enlightened economy: an economic history of Britain, 1700-1850* (London, 2009), p. 39.

<sup>1123</sup> Munck, T., *The Enlightenment: a comparative social history, 1721-94* (London, 2000), p. 3.

thesis has highlighted those characteristics. This has also been aided by the elaboration of elements of connectivity between sectors, such as Reynold's involvement with industrial innovation, cultural science and infrastructure improvement. In doing so it offers a different perspective to those offered by Trinder and also from the approach taken by Jones and Elliott. In examining the issue of regional Enlightenment in the manner in which it has, the thesis has moved the focus of attention away from the county's administrative and social centre, Shrewsbury, to the East Shropshire Coalfield, the north-west of the county with the Ellesmere Canal and across Shropshire in respect of agricultural and cultural development. It has also brought into perspective those influences that lay beyond its borders which reveal the permeable nature of intellectual boundaries.

The reference by Barrie Trinder to Shropshire enlightenment and the relevance of Joseph Plymley in its manifestation has been picked up by several other authors.<sup>1124</sup> The campaign of 1791/2 for the petitioning of Parliament for the abolition of the slave-trade brought a conjunction of interests within Shropshire: between the local coordinator of the protest, Joseph Plymley, and those seemingly with a moral or social opposition to the trade.<sup>1125</sup> Although abolition was achieved in 1807 it must be borne in mind that success was not won in Shropshire; it was achieved through political bargaining in London.<sup>1126</sup> Following the campaign and Parliament's deferral of abolition in 1792, the archdeacon's sister, Katherine,

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<sup>1124</sup> Trinder, B., *A history of Shropshire* (London, 1983, 2nd ed 1998), p. 79; *The Industrial Revolution in Shropshire* (London, 1973, 3rd ed 2000), pp. 107-8; 'Was there a Shropshire Enlightenment?,' *History West Midlands*, vol. 1, no. 1 (Spring 2013), pp. 26-29; Grounds, D., *Son and servant of Shropshire: the life of Archdeacon Joseph(Plymley) Corbett, 1759-1838* (Herefordshire, 2009), p. 236; Pattison, A., *The Darwins of Shrewsbury* (Stroud, 2009), p. 22.

<sup>1125</sup> Grounds, D., *Son and servant of Shropshire: the life of Archdeacon Joseph(Plymley) Corbett, 1759-1838* (Herefordshire, 2009), pp. 27-69.

<sup>1126</sup> Oldfield, J. R., *Popular politics and British Anti-Slavery: the mobilisation of public opinion against the slave trade, 1787-1807* (Abingdon, 1998), p. 84; Grounds, D., *Son and servant of Shropshire: the life of Archdeacon Joseph(Plymley) Corbett, 1759-1838* (Herefordshire, 2009), p. 69..

felt compelled to write of disappointment in how few had seemingly taken up the cause ‘upon fixed principles,’ referring to ‘novelty’ and ‘fashionability’ as apparent rationale for some.<sup>1127</sup>

After 1792, enlightened activity and the pursuit of economic, cultural and social improvement within the county were not centred upon Joseph Plymley and to position him as a nodal figure in Shropshire cultural enlightenment would be to overstate his stature. He was a respected figure through his position within the Church and as a magistrate and was committed to the enhancement of society, but then so were others and it is difficult to see that such a brief alliance of souls as was effected in 1791, was extended in any significant sense to the betterment of local society. In terms of intellectual activity, innovation was not promoted through the communion afforded by Plymley connections, unlike for example the Lunar Society of Soho. Whilst innovative and progressive individuals may have been creating an aura of change and improvement, the ties to such innovation as identified in earlier chapters are not traceable directly to Longner Hall.

Historians have commented that periodisation risks obscuring the dynamic of a process of evolution: it jeopardises the identification of those characteristics and values of a point in time, location or culture that maybe important to its conditioning.<sup>1128</sup> In this instance it restricts Enlightenment to a fixed period of time rather than being considered as a process engaged with over a variable span dependant on local specificity. Ultimately the expression ‘Enlightenment’ is a device that affords the opportunity to conceptualise and link social, political or cultural events in a particular time-frame and recognise them in the context of distinct patterns of behaviour. Many of the intellectual activities identified within the thesis reflected Enlightenment characteristics, but whether they reveal a coherent Shropshire

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<sup>1127</sup> Grounds, D., *Son and servant of Shropshire: the life of Archdeacon Joseph(Plymley) Corbett, 1759-1838* (Herefordshire, 2009), p. 69..

<sup>1128</sup> Brown, M., ‘Romanticism and Enlightenment,’ in Curran, S., (ed.), *The Cambridge Companion to British Romanticism* (Cambridge, 1993, 2<sup>nd</sup> Ed 2010), p. 39; Clark, W., Golinski, J., Schaffer, S., *The Sciences in Enlightened Europe* (London, 1999), p. 4; Munck, T., *The Enlightenment: a comparative social history, 1721-1794* (London, 2000), p. vii; See Chapter 2 of the thesis for detailed elaboration.

Enlightenment in action is less apparent. Aspects of technological, economic and cultural dynamism have been noted within the county, for which the appellation 'improvement' might be a better notion. The thesis concludes that there was important regional intellectual activity in the county revealing improvement in many different spheres but the term Shropshire Enlightenment, which implies a coherent movement, has to be applied with circumspection.

Appendix 3/1:

		L. s.
	Carried forwards	42, 100
The Marquis of Stafford	1000	Edward Blakeway 500
Lord Berkeley	1000	Edward Hynastons 500
John Corbet	2000	Henry Bevan 500
Thomas Oyon	2000	Richard Emery 400
Sanct John Charlton	2000	Corbet Browne 300
William Fyfeur	2000	James Hiles 300
Thomas Gilbert	2000	Robert Hawkins 300
John Gilbert	2000	Robert Pemberton Junr 300
John Wilkinson	2000	Elizabeth Freeman 300
William Reynolds	2000	Mary Slater 300
Joseph Reynolds	2000	Charles Roe 300
John Bishop	2000	Robert Smith 300
Stephen Leake	2000	William Shakeloff 300
Thomas Howwood	2000	William Yonge 300
Robert Burton Junr	1500	Mary Dunn 300
William Pasteney	1000	Edward Phillips 300
Theophilus Houllbrooke	1000	William Nickson 300
Richard Reynolds	1000	Robert Jeffreys 300
Edward Davies	1000	Thomas Elsmere 200
William Rathbone	1100	Humphrey Parson 200
John Locke	1000	Timothy Gage 200
John Bishop	1000	James Dixon 200
Robert Burton Junr	500	Richard Hukes 200
Francis Mabel Sparrow	500	Thomas Jones 200
Edward Burton	500	Thomas Hodgkins 200
Thomas Husband	500	John Parkes 200
Ben Johnson	500	Samuel Johnson 100
William Cherrington	500	John Edwards 100
Thomas Sandford	500	
Mary Curle	500	£ 50, 000
Elizabeth Davies	500	
John Colley	500	
Robert Waring Darwin	500	
Joseph Sutton	500	
Ralph Leake	500	
John Flint	500	
Samuel Gate Kenyon	500	
	£ 42, 100	

Subscribers to the Shrewsbury Canal

**Appendix: 3/2****Promoters of the Ellesmere Canal**

<b>Hill, Sir Richard, Bart. MP (1732-1808)</b>	2 <sup>nd</sup> Baronet of Hawkestone Park, Tory MP for Shropshire; religious revivalist; tolerant of dissenters. Benevolent disposition –generous and philanthropic
<b>Cunliffe, Sir Foster, Bart. (1755-1834)</b>	3 <sup>rd</sup> Baronet of Acton Park, Wrexham. Grandson of Liverpool slave trader and 3 time mayor of Liverpool.
<b>Kynaston, John (later Sir John Kynaston Powell Bart. (1753-1822).</b>	1 <sup>st</sup> Baronet of Hardwick. Tory MP for Shropshire (1784-1822); anti-Catholic. Remembered for integrity and urbanity. <sup>1</sup>
<b>Mostyn Owen, William, Esq.,</b>	Of Woodhouse, Shropshire; MP for Montgomeryshire.
<b>Hill, Sir John, MP ( -1824)</b>	Of Hawkestone Park.
<b>Hunt, Rowland, JP (1752-1811)</b>	Of Boreatton Park, Shropshire; Justice of the Peace; Commissioner for building of new gaol and House of Correction.
<b>Bishop, John</b>	Mayor of Shrewsbury (1790-1); Mercer; Partner of Wm Reynolds & Thos Eyton in bank; described in legal documents as ‘gent. of Shrewsbury; stands as trustee or ‘assignee in bankruptcy’ in extant legal documents.
<b>Wilkinson, John (1728-1808)</b>	Ironmaster; home at Broseley, Shropshire; ironworks in Shropshire, Staffordshire and at Bersham and Brymbo in Flintshire near planned route of Ellesmere Canal. Bradley ironworks on line of Birmingham Canal.
<b>Greenwollers, Charles Garland</b>	Solicitor of Took Lane, London; Also of Sloop Hall, Salop; married into Corbet family
<b>Lloyd, Rev. John Robert</b>	Of Aston Hall nr Oswestry, Shropshire; later father in law to Hon Thomas Kenyon, MP. <sup>1</sup>
<b>Kynaston, Rev. Edward</b>	Rector of Risby and Fornam, Suffolk; Brother and heir to John Kynaston. <sup>1</sup>
<b>Turner, William</b>	Engineer;

## Appendix: 4/1

### Bage Letters- chronological sequence

27 July 2012  
11:48

#### Summary of Bage/ Strutt Letters 2657/

Subject code	ShRO Ref 2657/	Date	Content description
	/2	No date (1795/early 1796)	Inverted arches /Expansion of iron/ settlement of brickwork/ J. Reynolds tests
	/3-5		Skempton letters re above
	/1	15/10/1802	Drying stove & planned layout, pots
	/10	11/11/1802	Inverted arches/ plan of stove layout
	/16	N d-post 11/11/02/pre 5/1/03	My last re spherical arches & hexagon bricks
	/6	5/1/1803	Re WS health
	/9	No date	Plan of iron frame roof
	/14	19/05/1803	Strength of pillars
	/13	29/8/1803	Intro re experiments on roof frame
	/15	No date (supp to /13)	"Concerning the strength of beams"
	/12	No date (supp to /13)	Experiments on strength of iron roof frame.
	8	22/10/1803	Health issue re tumours
	/9(2)	5/3/1805	Vacuum in pump/inverted pots
	/7	16/10/1806	Cooking stove/ evaporation of large pot
	/11	21/2/1807	Domestic cooking stove (see 7)
	/33	8/5/1807	Piano
	/34	8/5/1807	Gas lighting
	/35	5/3/1808	Gas lighting/bleaching/spinning
	/36	26/10/1808	Bleaching/zinc reflectors
	/37	4/5/1809	Small pipes/zinc reflectors
	/23	N.d. Pre 3/4/1810(/38)	Temperature control of room/ Bleaching
	/38	3/4/1810	Temperature control/ Gas bleaching
	/24	5/8/18(10?)	Bleaching
	/25	4/11/1810	Bleaching
	/26	24/1/1811	Look for partnership/Bleaching/ thermometer
	/27	April 1811	Re partnership/Bleaching/Temperature control
	/28	28/10/1811	Gas lighting/ Fire at Marshalls
	/29	22/7/1812	Lancasterian school
	/30	27/9/1814	Spindles/fine thread/ Bleach
	/19	2/1815	Next Sunday's visit
	/31	26/2/18(15?)	Bleaching/Benyon separation/Absorption box
	/32	4/4/1815	Absorber/Nothing to do
	/22	June 1816	Count strokes of fly wheel/ Whitehurst/cotton broker/Absorber
	/20	14/7/1816	Counter/ correction of Strutt/ power loom
	/21	Undated(?after 14/7/1816)	Counter/theorem
	/18	25/2/1818	Counting m/c
	/17	11/8/1818	Idleness/power looms/Darwin

Key:

-  Building/Arches
-  Ironwork
-  Gas lighting
-  Bleaching
-  Temperature control
-  Engine counter
-  Domestic cooking

**Appendix: 5/1:**

Shifnal Agricultural Society- List of Subscribers 3<sup>rd</sup> March 1800

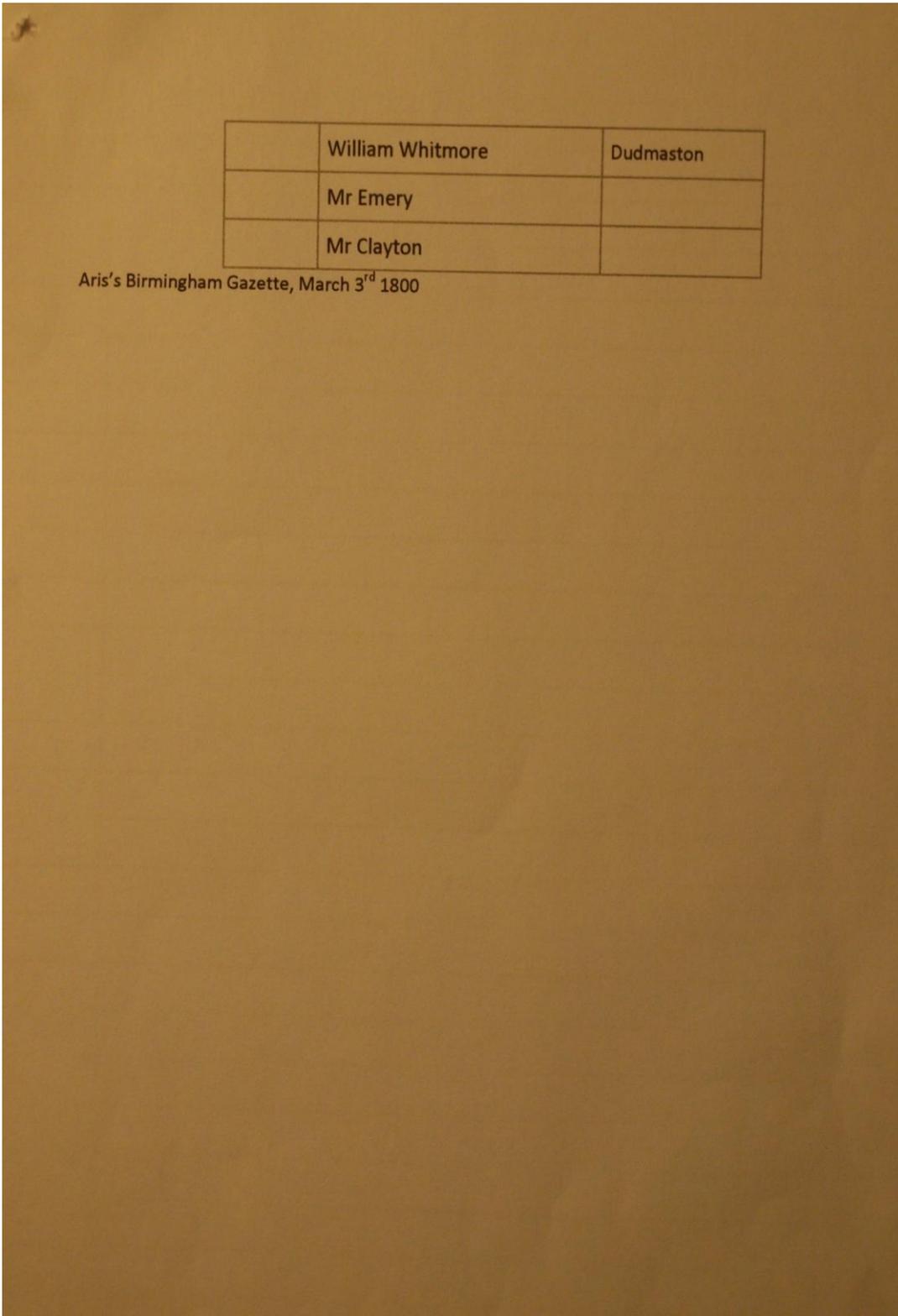
	Sir George Pigot	Patshull
	John Cotes	Woodcote
	Sir Wm Jerningham	Shifnal Manor
	George Jerningham	Shifnal Manor
	George Brooke	Haughton
	Thomas N Parker	Hatton
	Thomas Mackrell	Shifnal
	Charles Firchild	Burlington
	Richard Mackrell	Shifnal
	John Ward	Heathill
	Thomas Skrymsher	Ryton
	John Cherrington	Aston
	George Baylis	Neach Hill
	Robert Pigot	Patshull
	Samuel Smith	Stanton
	Robert Dean	Shifnal
	Joshua Williams	Deckerhill
	Richard Phillips	Brockton
	Lord Bradford	Weston
	John Eyke	Stanton
	John Cherrington	Kemberton
	Thomas Green	Wooton
	Edward Owen	Albrighton
	Rev. Thomas Lloyd	Albrighton
	Revel Phillips	Shifnal
	Richard Langley	Upton
	John Bishton	Kilsall
	Thomas Ward	Lea Hall

**Shifnal Agricultural Society- List of Subscribers 3<sup>rd</sup> March 1800**

Appendix: 5/1 (2)

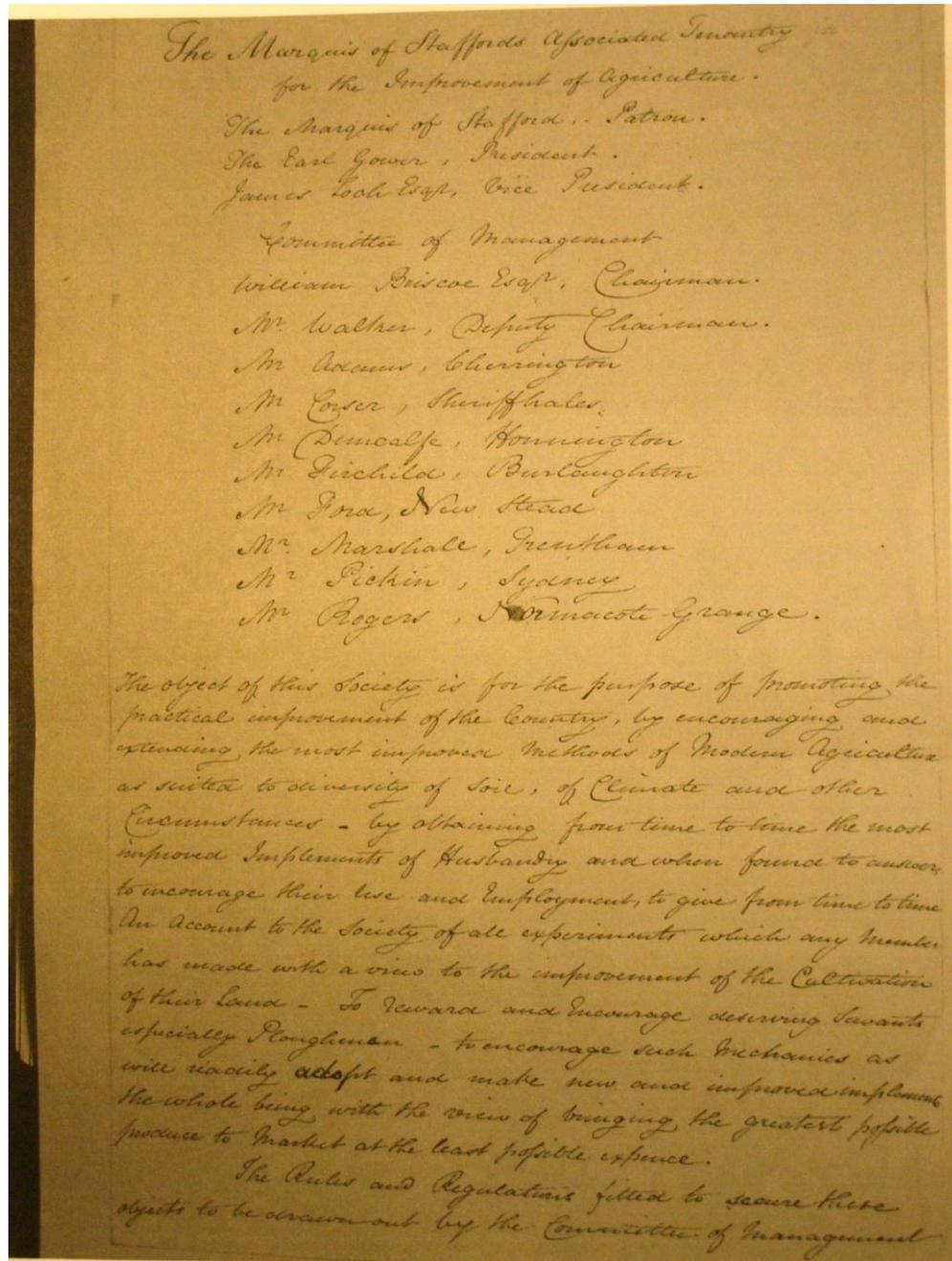
William Phillips	Brockton
Joseph Owen	Albrighton
J. H. Browne	Badger
Thomas Whitmore	Apley
George Forrester	Willey
Robert Slaney	Hatton
M. A. Slaney	Shifnal
George Appleby	Shifnal
William Rushton	Wyke
Samuel Harding	Grindle
Thomas Bate	Woodside
George Jellicoe	Chatwell
George Wyatt	Shifnal
John Moultrie	Aston
Bart. Masefield	Shifnal
Robert Roden	Shifnal
Thomas Paddey	Drayton Lodge
Samel Jones	Hatton
William Botfield	Malinslee
Edward Cartwright	Kemberton
William Phillips jun	Brockton
John Plant	Hardwick
John Owen	Pepperhill
Rev Archdeacon Woodhouse	Donnington
John Bishton jnr	Kilsall
Benjamin Rowley	Priorslee
Rev George F Molineux	Ryton
G. C. Nicholls	Windmill
Samuel Bennett	Shifnal
Rev Charles Buckeridge	Tong
William Gould	Wem

**Appendix: 5/1 (3)**



**Shifnal Agricultural Society- List of Subscribers 3<sup>rd</sup> March 1800 (3)**

The Marquis of Stafford's Associated Tenantry



'Constitution of the Marquis of Stafford's Associated tenantry,' Staffordshire Record Office

**Appendix: 5/3**

**Letter from James Loch to Capt. R. H. Bradshaw of the Liverpool and Manchester Railway, 12<sup>th</sup> October 1826**

"...having spent the greater part of yesterday at Darlington looking over the railway and travelling along it in one of the coaches which I hired for the purpose.

The Railway itself is most imperfectly executed and therefore all the results are less favourable by far than if it was made with the accuracy and nicety which it is capable of.

The two chief defects are that there is not one joint which is not loose or open, the former is owing to the mode of fastening being nails thro' the rails and the chairs, none of which are properly rivetted, a large proportion of them having actually come out and all being loose. This defect will be in a great degree cured by the new mode of fastening, which is to be adopted in the Liverpool Railway, namely fastening them to the chairs by keys. From what I observed however I am strongly of opinion that chairs upon which the ends of rails rest, should be twice the length of the other chairs, in order to give the rails a better hold and support, and thus enable them to resist more effectually the jirk (sic) which they get upon the wheel passing from one nail to the other. Little care seems to have been taken in bringing the edges of the joints to the same level and indeed there appears to be considerable practicable difficulty in doing this, as in the Railway laying down by Lord Carlisle, where every pains have been taken to avoid this, I had the same fault to complain of. I am clearly of opinion from witnessing the most injurious effects which this jirk produces, that very great attention should be paid to this part of the work, by selecting rails, which are to meet, of the same size exactly and that their ends should be cut or filed before they are laid down and filed after they are their places so as to reduce them to one uniform surface and bearing.

Another defect which most of the rails had, was that they all had a side waving motion and I observed this also in a lesser degree on Lord Carlisle's, owing to little attention having been paid to make the rails fit the chairs, or to make the shoulders of the rails rest or bear upon the Chairs. This a most material object to attend to, for if this motion exists when the motion along the rail is rapid it shakes the block upon which the chair is fastened and thus destroys the whole consistency of the Railway.

This would be best remedied by the block being long enough to extend across the railway, so that both chairs might rest on and be fastened to the same stone blocks. Unless this is done to some extent at least, I am confident we shall soon have reason to regret its not being adopted. It may be too expensive to adopt at each block, but it should in my opinion be adopted at each length and in place of making the rails join opposite to each other I would recommend them to be joined half length and half length, with one of these large blocks at every joint. In this you would unite the whole length of the Railway and both sides into one connected piece of work, which it would be difficult to displace and each part would give the other strength, in place of every rail being in fact unconnected with the other and the two sides totally separated and liable to be moved and pushed out. In order to give the horseway proper room the horseway might be hollowed out thus.

I am aware that the expense would be considerable but the advantages to be derived both from its greatest lastiness and the greatest precision it would give to the conducting carriages rapidly along it and would soon repay this additional expense.

I cannot help thinking likewise that this tendency which the rails have to shake sideways is owing to their not having a sufficiently wide base to stand on. This I think should be seriously considered and if it shall be determined that I am wrong, I certainly strongly recommend, the greatest attention being paid to the chairs and rails being made to fit more accurately all the shoulders of the rails.

The opening of the joints being chiefly near to the batteries, I conceive that they have been pulled out of their original position by the consolidation of the earth.

Notwithstanding these defects I found the Railway capable of much greater things than I expected, especially as the means of carrying passengers, and I look forward to this being one immense source of profit to our railway indeed to an extent hardly contemplated.

There was no communication between Darlington and Stockton previous to the Construction of the Railway. They first tried a coach which did not succeed. By reducing the fares however to a halfpenny a mile there at present six coaches on the line, three each way fully employed. It is difficult to say how many passengers they carry, as they contrive at times to put on them from 30 to 40 people. They are drawn by one horse which draws the carriage between these two towns a distance of 12 miles in one hour and a quarter and back again. When fully loaded as above in one hour and thirty five minutes. Their usual and ordinary rate of going both up and down is as near as possible ten miles an hour. I think the population of these two place does not exceed 10,000 souls and have little commercial connection and not much enterprise. This branch of their revenue already produces above £800 a year. How much would this amount be between Liverpool and Manchester? It is difficult to calculate. I am convinced we shall see the Edinburgh mail carried this way.

But here again I remarked inconvenience on our way to Stockton. We did not meet one carriage, but we passed several, not many. This was precisely as one of the branches of the Liverpool Railway will be. There are passing places in every quarter of a mile, yet the detention was considerable. Between Liverpool and Manchester it would be fatal, where the number of carriages going at various speeds would exceed in a tenfold proportion that we experienced at Darlington and I am thoroughly satisfied that no system of police or arrangement can cure the evil. Four ways is the only practicable remedy- two for the quicker and two for the slow carriages; provided the latter are conceived to form an important object. I think it should be well-considered what the difference in the expense would be, between forming a railway on this footing and one with two ways and a sufficient number of passing places. Indeed I had always supposed until I saw Messrs Harrison, Pritt & co last in London that it was intended to have four ways. If they intend sending much coal to Liverpool, I conceive it quite impossible to do with two ways near the town. Indeed no one who has not seen the inconvenience can judge of its magnitude. It certainly forms the most decided objection to Railways becoming the general means of communication throughout the Country for Stage Coaches.

I saw four locomotives at work. They are decidedly imperfect machines, Large, lumbering and inconvenient and I am not quite sure they are economical. They are decidedly only in their infancy and as much

thought and talent have not as yet been applied to their construction and improvement. It may be unreasonable to have expected more than has been accomplished.

Those I saw each drew 24 Chaldron wagons, weighing themselves 30 tons, their cargo 60 tons, in all 90 tons, the rate to which they are limited 5 ½ miles an hour. One went lately to Stockton at 9 miles the whole way. Returning they fetch back I think 8 empty wagons, but then some part for the Railway is as steep as one in 128, 135 and 144; one in 192 is the proper declivity for a locomotive to overcome and no more.

At the inclined plane I saw, the descent was 1 in 33, length 1 mile 91 yards and on the other side 1 in 31 ¼, length 825 yards. The engine drew up repeatedly 8 waggons equal to 20 tons of coal, and 10 tons the wagons=30tons, at the rate of ten miles an hour.

I think I have thus got through all my descriptions of what I saw and examined but I could make little of cost of conveyance etc. They told me that they paid a halfpenny a ton per mile for horse power, the company furnishing carriages, that they paid for locomotive power a farthing per ton per mile, the company furnishing the engine and the wagons. That the result was a saving to the company of £120 a month which after deducting £30 per month for the tear & wear (sic) int: on capital etc etc left the real saving to the company in employing locomotive power £900 a month. Of course I have no means to correct the accuracy of this statement.

As I cannot help thinking that some of the foregoing observations are worthy of consideration and tho' they may not be fit for adoption, yet as they may suggest more efficient remedies for the defects which are visible to anyone who examines this railway with attention..”

**A letter from Mr John Warltire, Lecturer in Natural Philosophy to Dr Joseph Priestley, on the firing of inflammable Air in close vessels, Birmingham 18<sup>th</sup> April 1781**

Sir,

I had long entertained an opinion that it might be determined whether heat is heavy or not by firing inflammable air mixed with common , and applying them to a nice balance, but as I conceived the danger of passing the electric spark through so combustible a mixture in a close vessel to be greater than it is, I was deterred from making the experiment 'till being encouraged by you. I procured a copper ball, or flask, which holds three wine pints, the weight 14oz. with a screw stopper adapted to it, and began with small quantities of common air, which were fixed without the least danger.

I then increased the bulk of the inflammable air to half that of the common air, which when fired made the flask very warm to my hand, and every time I applied a long glass tube fastened to the pipe of a pair of bellows to blow the phlogisticated air out of the flask, I observed a smoke escape along with it. I also fixed the air when the flask was under water, and did not observe anything escape when I perceived the heat against my hand which I kept the ball from rising. When the stopper was unscrewed, the external air always rushed into the vessel containing the phlogisticated air with some violence.

The method I usually practice to mix the airs in any proportion, is accurately to fill a measure with inflammable air, and rest it in a tub, with its rim barely under water, hanging over the edge of a shelf, so far as to admit one leg of an inverted syphen (sic), the other leg being closed, but afterwards opened, and the copper flask inverted upon it but closed with its stopper when the measure of air has been plunged under water, to force it out through the syphen. I have sometimes exhausted the common air to admit the inflammable air into the flask, but I do not find that circumstance produces any difference in the result of the main experiment.

My next object was to adjust the balance in such a manner as that I could always be certain to weigh less than a grain when it was loaded with the flask and its counterpoise and I constantly examined it at the beginning and end of every experiment. The apparatus being adjusted, I proceeded to make the experiment I had in view and always accurately balanced the flask of common air, then found the difference of weight after the inflammable air was introduced, that I might be certain I had confined the proper proportion of each, the electric spark having passed through them the flask became hot, and was cooled by exposing it to the common air of the room; it was then hung up again to the balance, and a loss of weight was always found, but not constantly the same; upon an average it was about two grains.

I have fixed air in glass vessels since I saw you venture to do it, and have observed, as you did that though the glass was clean and dry before, yet after firing the air, it became dewy, and was lined with a sooty substance.

If you think these experiments worth communicating to your philosophical acquaintances it may be depended upon that the circumstances appeared to me as I have represented them, whatever they me found to prove.

I am with great esteem

Your humble servant

John Warltire

Source: Published as an addendum to Priestley, Joseph, *Experiments and Observations relating to the various branches of Natural Philosophy*, Vol. 2, Birmingham, 1781,

**Appendix 6/2:**

**Transcript of an advertisement for Thomas Yeomans**

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**The Most Capital Experiments of Thomas Yeoman- Feb. 16, 1746**

1. To shew what Bodies are Electrical, and what are not.
  2. To prove that these wonderful Effluvia will not be conveyed by an Electric Per-se.
  3. To shew it is the property of these Effluvia to attract and repel alternately all light Bodies that are brought within the Sphere of its Activity.
  4. To prove the Ingress and Egress of the Electrical Effluvia to and from the excited globe.
  5. To shew that Electricity differs from Magnetism, and that the one does not interfere with the other.
  6. To shew the action of Electricity upon the Nerves.
  7. To prove that the electrical power accelerates the Motion of Fluids.
  8. The Motions of the Planets and Comets shewn by an Electrical Orrery.
  9. Spirits of Wine fired by the Electrical Spark.
  10. To shew that a Watch when Electrified will go faster than before
- With many other Experiments, particularly a Jet de Feu, Streams of Water made luminous, the Electrical Fire appearing like lightning, the Electrical Effluvia resembling the Aurora Borealis; together with the Manner in which lightning strikes several Bodies instantaneously, etc.

Each person to pay one shilling.

Source: *Northampton Mercury*, 16<sup>th</sup> February 1747, Northamptonshire Record Office.

**Appendix: 6/3**

**An extract from an advertisement for John Warltire's Course on General Chemistry given at Cook's Coffee House, Cherry Street Birmingham commencing 10<sup>th</sup> June 1782**

Lectures given under the following heads:

1. Chemistry
2. Heat
3. Fluidity
4. Minerals
5. Crystallisation
6. Assaying
7. Gold, platinum or mercury
8. Silver, copper, lead, tin
9. Zinc, cobalt, antimony
10. Dying and colours
11. Agricultural substances
12. & 13. Minerals

By way of exemplification of lecture content:

“Lecture 9:- Upon zinc, cobalt, antimony and bismuth- observations on metals and semi-metals, the solution and fusibility of them, their calcs and degrees of volatility, their salts and uses they are applied to . Sympathetic inks, antimonal preparations, observations upon arsenic and nickel.”

Source: *Aris's Gazette*, 10<sup>th</sup> June 1782.

## Appendix: 6/4

### Transcription of an advertisement for Adam Walker

An extract from an advertisement for Adam Walker's Astronomical lecture on the Eidouranion or Transparent Orrey given on 5<sup>th</sup> November 1781 at New Theatre, Birmingham.

"The Eidouranion exhibits:

1<sup>st</sup>. The Ptolomaic System of the Universe in Transparency.- 2ndly. That part of the Copernican System that relates to the sun's motion on his Axis. The Earth's Motions, both annual and Diurnal; showing thereby, how Day and Night, long and short Days, the Seasons, &c. are produced; so evident and like Nature, that a bare inspection of the Machine, and a Quarter of an Hour's attention, may give the most Ignorant a clear Idea of the Phenomena.- 3dly. The Motion and Phases of the Moon.- 4thly. The Earth and Moon's Motion around their common Centre of Gravity; and how Spring and Neap Tides are produced.- 5thly. A Transit of Venus.- 6thly. A Grand Display of the whole Solar System, viz. the Sun, Mercury, Venus, the Earth and Moon, Mars, Jupiter, Saturn, and their Satellites, all in motion without any visible Machinery; Together with the Parabolic Descent and Ascent of a Comet."

Source: *Aris's Gazette*, 5<sup>th</sup> November, 1781: also Langford, J. A., *A century of Birmingham life or a chronicle of local events from 1741 to 1841*, Birmingham 1868, vol. 1, p 251.

## Appendix 6/5

### Analysis of List of members of SNWNHS 1835/6

S'name	Total	Female	Nobility	Gent/ Esq	Rev	Dr	Mr	Occupation (Incl.)
A	5			4	1			
B	31	2	1	17	5		6	
C	22		1	13	4		4	Music master; Mason; Ironmonger
D	15		1	8	1	2	3	Bookseller; Optician
E	6			3	2		1	
F	2			2				
H	20	1	1	9	6		3	
J	9			6		2	1	Wine merchant
K	2	1		1				
L	9	2		4	2		1	
M	5			4			1	
N	1				1			
O	2			2				
P	11		1	4	1		5	
R	1				1			
S	14	2		8			4	
T	1				1			
V	2			1	1			
W	15	1		7	2	1	4	Chemist
Y	1				1			
	<b>174</b>	<b>9</b>	<b>5</b>	<b>93</b>	<b>29</b>	<b>5</b>	<b>33</b>	

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