Lead production on the northeast periphery: A study of the Bowes family estate, c.1550-1771

BROWN, JOHN,WILLIAM

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John W. Brown

Abstract

This is a study of a family estate's relationship with a high value mineral product. It aims to fill a knowledge gap in the extractive industry's history in the Northeast by examining the lead production process on Bowes' lands. The behaviour of the landowner as mineral lord and the extent of any individual's role is the over-arching theme. It involves the study of the gentry as entrepreneur, and the key role of the estate steward. The economic relationship between the region and the nation is also illuminated through the Bowes family's activities in both the North-East and London. The main focus is on the Bowes estate between 1720 and 1760 as this was the period when George Bowes was actively involved in developing the lead mining industry on his estates in North-East England.

The chapters that follow examine the Bowes family's relationship with lead between 1550 and 1771. Chapter 2 attempts to establish the roots of this relationship in the sixteenth century; Chapter 3 focuses on the swing to inactivity in the lead business during the first half of the seventeenth century, followed by less passive involvement from the late 1670s into the early eighteenth century. The period of George Bowes patriarchy then becomes the focus of the thesis: Chapter 4 discusses the organisation and management of lead production on the Bowes estate in the mid-eighteenth century; Chapter 5 the development of lead mining; Chapter 6 smelting and related activities; Chapter 7 the lead market and carriage; chapter 8 the role of George Bowes; and Chapter 9 the transitional period between 1760 and 1771 prior to the arrival of the London Lead Company.

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John William Brown

Doctoral Thesis

Department of History

University of Durham

2010

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Abbreviations

AgHR	Agricultural History Review
DCRO	Durham County Record Office
D/St	Strathmore Papers catalogue reference at DCRO
EcHR	Economic History Review

GLOSSARY

Adit	An inclined tunnel driven, sometimes to drain a mine, into a hill or valley side to access the lead vein
Adventurers	Shareholders in a mine
Assay	A test of ore for concentrate and silver
Bail, Bole, Baal hill	A smelting place consisting of stone on three sides which was fired using wood and lead ore
Bing	Eight hundredweight of lead ore
Bingstead	A storage area where lead ore was dumped before smelting
Bingtale	Contract with miners for payment by weight of washed ore
Blackwork	oxidised lead smelted in a bole, part left for the second firing, and part smelted in an oven
Bouse	Ore directly from the mine undressed
Bucker	Flat-headed hammer to break waste from ore on the knock stone
Concentrate	Lead ore dressed ready for smelting
Crosscut	Level between two veins driven through dead ground
Cupola	Old name for smelting furnace
Deadwork	Driving through ground where there is no ore
Dress	To remove waste materials from ore ready for smelting
Fathomtale	Contract with miners for payment by distance driven
Flat	Horizontal ore deposit
Fother, fodder, fudder	Weight by which smelted lead was sold. This measure varied
Galena	Lead sulphide (PbS), the most commonly found ore of lead
Gangue	Waste materials attached to lead ore
Gavelock	Iron crowbar used for stirring the contents of an ore hearth

Gin	Horse driven machinery for lifting out of mine
Groove, grove	Old term for a lead mine
Hush	Removing surface materials using a rush of water to reveal a lead vein
Kibble	Bucket for ore
Knock stone	Large flat round stone upon which ore was broken using bucker
Lease	Agreement of more than a year between the mineral lord and adventures or miners to work
Level	Driven from mine shafts to form galleries for working
Liberty	The area where the miner was permitted to find and mine for ore
Meer	Area or tract of land, measured in yards along the vein, where mining was permitted
Mine shop	Lodgings for lead miners
Ore hearth	Furnace where peat (or coal) was used as fuel, blown by water-powered bellows, for smelting lead
Pig	Cast lead piece in the form of an oblong with round ends
Rake	Vein of lead in a vertical fissure running across the land
Slag	Waste material produced in both bole and ore hearth smelting which could be re-worked to make slag lead
Slag hearth	Furnace with hotter temperature to re-work slag and a make slag lead, which was less pure than ore hearth lead
Smelting mill or house	Building containing ore and slag hearths, water-powered
Sough	Tunnel or adit for draining a mine
Stamps	Machine for reducing size of ore before smelting
Stemples	Short timbers across the lead vein as platforms for waste
Stoping	Working overhead vertically up he lead vein
Stowe	Wooden windlass positioned over s shaft for raising ore

Tack	Usually a one-year license to explore for lead
Tontale	Contract with miners for payment by weight of lead smelted
Turnbole	A variation on the bole, developed in Durham, whereby the furnace could be revolved to face the prevailing wind

WEIGHTS & MEASURES

There is a broad range of weights and measures in the British lead industry, the origins of which are probably regional. Those outlined below apply to the Bowes estate and the northeast in general during the period covered by this thesis, and should not be taken as standard for the rest of Britain.[1]

In the eighteenth century:

14 lbs = 1 stone

16 stones = 224 lbs = 2 hundredweights (cwt)

1 ton = 20 cwt = 160 stones = 2240 lbs

Lead ore:

1 poke = 112 lbs = 8 stones

1 horse (load) = 2 pokes = 224 lbs = 2 cwt

4 horse (loads) = 8 pokes = 1 bing = 896 lbs = 64 stones = 8 cwt

Metallic lead or pig lead:

Fother or fodder or fudder was generally used as a measure when lead was sold, but there were variations according to the local market/port:

Newcastle	2352 lbs = 21 cwt
Stockton	2464 lbs = 22 cwt

Lead was smelted into pieces or pigs:

16 pieces or pigs = 1 fother

[1] Weights and measures used on the Bowes estate are confirmed in *D/St/B2/162*

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Acknowledgements

There are numerous individuals I wish to thank for their help support during the past seven years. I would like to thank my supervisors, Professor Ranald C. Michie and Dr. Adrian G. Green of Durham University's History Department, for their patience and boundless enthusiasm; Professor Chris Brooks at Durham and Professor Keith Wrightson at Yale for their insightful comments and thoughts on various aspects of my work; Margaret McCollum (now retired) in the Department of Palaeontology at Durham and Chris Brooks for their assistance in understanding and transcribing late sixteenth century documents; Dr. Christine Newman for her detailed knowledge of sixteenth century Bowes family history; Mike Gill for lengthy telephone conversations and answering many questions about lead mining technology; and the very able and knowledgeable archivists and staff of the Durham County Record Office. Lastly, I should thank my examiners, Professor Roger Burt and Dr. Ben Dodds, for their constructive criticisms and guidance.

Dedication

This work is dedicated to my late Mother, Vera Brown (1924-2009), no ordinary woman, who did not live to see its completion but without whose courage and sacrifice it would not exist.

Chapter 1: Introduction

Recently, bemoaning the absence of academic research into non-ferrous mining in the mineral economy, Burt resurrected the debate regarding the underestimated significance of the role of the extractive industries in creating 'the defining context for the whole process of…industrialisation'.[2] This thesis is a case study of one family estate's relationship with a high value mineral – lead. It fits into the general historiography covering landownership and absenteeism, estate management, proto-industrialisation, and the economic and social history of the northeast. Although the subject of this thesis falls into the wider literature on estate management and protoindustrialisation, it develops a distinctive approach by focusing on lead mining on the Bowes estate in the mid-eighteenth century.

The literature on landowners is mainly concerned with estate management as a whole, and where minerals are concerned it is coal not lead that is paramount. H. J. Habakkuk's 'Economic Functions of Landowners in the Seventeenth and Eighteenth Centuries' in *Explorations in Entrepreneurial History, VI* (1953) was seminal. The role of landed estates in the process of early industrialisation through exploitation of mineral rights is given a very broad treatment by G. E. Mingay's *English Landed Society in the Eighteenth Century* (London 1963) and *The Gentry: the Rise and Fall of a Ruling Class (London 1976),* whilst J. T. Ward & R.G. Wilson (eds) *Land and Industry: the Landed Estate and the Industrial Revolution* (Newton Abbot 1971) contains a chapter on landowners' exploitation of minerals, including lead, but chiefly in the nineteenth century. J.V. Beckett in *The Aristocracy*

[2] R. Burt, 'The Extractive Industries', in R. Floud and P. Johnson (eds) *The Cambridge Economic History of Modern Britain, Vol. 1 Industrialisation, 1700-1860* (Cambridge 2004) pp. 417-418.

in England 1660-1914 (Oxford 1986) draws on the full range of previous publications to summarise his subjects' developmental role on their estates. Another aspect of landownership, absenteeism, was dealt with by P. Roebuck in 'Absentee landownership in the seventeenth and early eighteenth centuries: a neglected factor English agrarian history' in the *Agricultural History Review xxi, 1* (1972).

Academic interest turned to estate management and stewardship: G.E. Mingay, 'The Eighteenth Century Land Steward' in E.L. Jones & J.D. Chambers (eds) *Land, Labour and Population in the Industrial Revolution* (London 1967); D.R. Hainsworth, *Stewards, Lords and People: the Estate Steward and his world in later Stuart England* (Cambridge 1992); and J.R. Wordie, *Estate Management in Eighteenth Century England: the building of the Leverson-Gower Fortune* (London 1982) which focuses on coal. J.V. Beckett's *Coal and Tobacco: the Lowthers and the economic development of West Cumberland, 1660-1760* (Cambridge 1981) also concentrates on a family estate's development of coal. P. Hudson's (ed) *Regions and Industries: a perspective on the Industiral Revolution in Britain* (Cambridge 1989) examines the role of the region in industrialisation, but estates and lead do not feature on the northeast's pathway to growth. The hypothesis of proto-industrialisation stems from J. Thirsk's 'Industries in the Countryside' in F.J. Fisher (ed) *Essays in the Economic History of Tudor and Stuart England in Honour of R.H. Tawney* (Cambridge1961). It was F.F. Mendels who advanced the model of proto-industrialisation in 'Proto-Industrialisation: the First Phase of the Industrialisation Process' in *Journal of Economic History XXXII, 1972*, and thereafter followed much debate and study of rural industries. L.A. Clarkson outlined the whole debate and indicated the concept's limitations in *Proto-Industrialisation: the First Phase of Industrialisation?* (London 1985). Yet the lead industry does not appear; textile

industries predominate in descriptions of proto-industrialisation. More recently, M. Gill attempted to rectify this weakness by arguing for the role of lead mining in 'Mining and Proto-Industrialisation' in *British Mining no.41* (1990). This was followed by R. Burt 'Proto-industrialisation and "Stages of Growth" in the Metal Mining Indutries' in *The Journal of European Economic History* Vol. 27 no.1 (1998), which presents the case for the inclusion of small scale, regional, rural metal mining in the proto-industrial model.

Analysis of the Bowes estate's experience in Upper Teesdale will contribute to our knowledge of the history of the lead industry in the northeast, which until now has been dominated by study of the London Lead Company and the Blackett-Beaumont organisations.[3] This study addresses aspects of change and continuity across two centuries in an estate's handling of mineral rights, extending both our knowledge of an important extractive industry and contributing to wider debates, such as landlord absenteeism, the estate as 'firm' and gentry entrepreneurship – including the roles of different family members - the estate steward, regional relationships and links with London, and proto-industrialisation. The main focus is on the Bowes estate between 1722 and 1760, when George Bowes as patriarch was actively involved in generating lead production on the family estate, when he was supposedly the archetypal absentee landlord.

The aim of this thesis is to fill the gap in our knowledge of the lead industry in northeast England by examining the production process – finding lead, mining, smelting, and the lead trade through the participation of the Bowes as a landed gentry family. This study will focus on the Bowes estate and its relationship

[3] See historiography below in the introduction pp. 8-12.

with lead from the mid-sixteenth century through to 1771, when Mary Eleanor, George Bowes' daughter and sole heir, married and the family's lead mines were leased mainly to the London Lead Company. It will investigate whether the family were gentry entrepreneurs or absentee landlords as far as the exploitation of their mineral resource was concerned. The nature of their entrepreneurship – the extent of individual involvement over the generations – will also be revealed. The Bowes contribution to the development of an extractive industry will be considered within the context of the northeast, a region rich in factor endowment because of mineralisation.[4] By 1700 they were mineral lords who could have chosen to maximise the advantage of coal resources and ignore other economic activity, or behave dynamically and take the opportunity to develop another natural advantage. Lastly, the Bowes family lead business will also help clarify the relationship between the northeast and London during the period in question, largely owing to George Bowes' role – he was MP for County Durham from 1727 until his death in 1760 – in the development of the estate.

[4] Mineralisation is the process by which minerals appear in the geology of the terrain. In the case of lead ore it is produced by the circulation of fluids, probably of igneous origin, which penetrate the rock strata – carboniferous limestone in the Pennines – and become deposited. See J. Percy, *The Metallurgy of Lead* (1870).

The research for this thesis can be justified in several ways. There is a gap in the knowledge of lead production in the northeast, and because of the location of lead veins this relates directly to Bowes lands in the region. The behaviour of the landowner as mineral lord and the extent of any individual's role is interesting, because there are few studies of this kind for the period under examination. The relationship between region and nation can be illuminated through the Bowes' activities both in the northeast and London. A study of lead production in a region with high factor endowment will contribute to the debate about proto-industrialisation, as it fed into both regional and national markets. Lastly, entrepreneurship and management on a landed estate behaving as a firm can be explored as a catalyst for change.

As far as methodology is concerned, this research exploits original sources, and in particular the Strathmore Papers, a substantial collection – 142 box files, 2000 volumes, 412 boxes of manuscripts, and 300 plans - housed at the Durham County Record Office, where cataloguing was only completed in the 1980s. [5] There are also Bowes family papers at Glamis Castle which are largely personal and correspondence. Although it is recognised that there may be some limitations in using only the Strathmore Papers, the estate records at the DRO became the focus of research because they contain the lead business documents and George Bowes' correspondence. A body of documents relating to lead from the sixteenth century through to the late eighteenth century onwards was identified during initial investigations and became the basis for this thesis. The study will apply the methods of economic history because it will focus on both quantitative data – in terms of production of lead ore and metallic lead, productivity, and the financial aspects of the

[5] DURHAM COUNTY RECORD OFFICE (DRO) *D/St.*

lead business – and qualitative in terms of the role of individuals. The quantitative and qualitative elements are both supported by the documentary evidence. It is evident that during the George Bowes epoch many of these documents – including letters, journals, ledgers, cash accounts, bank accounts, and receipts – were kept accurately regularly. Coal predominates, but lead and salt held far greater importance than perhaps would be expected. Personal and business correspondence offer insight into his management, organisation, and decision-making and evidence his acumen and astuteness. These sources do, however, pose several problems that require brief discussion in order to understand their usefulness and any inherent limitations, particularly those from which statistical data has been derived.

The Strathmore Papers contain only a handful of records relating to the Bowes lead interests in the sixteenth century, and none before the 1550s. Consequently, the extent to which various Bowes family members were involved in mineral extraction at different times and places throughout the sixteenth century, largely appears in secondary sources which examine the histories of mines, mining areas, Crown interest, and mining monopolists. The significance of the Strathmore documents lies in their content: detailed information regarding amounts of pig lead traded, the individuals involved, the sums of money that changed hands, and trade between the northeast and London. These details enhance the perspicacity offered by secondary sources about Bowes' activities in the lead industry, albeit to only a limited degree, and especially in the northeast with its Newcastle entrepot.

There are no records for amounts of lead ore mined or pig lead smelted during the second half of the sixteenth century, nor are there any accounts for expenditure or income. Fortunately, some documents relating to trade have survived for the years

1568, 1576, 1580, and 1593.[6] These indentures are well written and highly detailed business documents giving some idea of the mechanism of the Bowes lead trade, amounts of money involved, the types of interested individuals, and the trading ports. The style and wording is of a legal nature, verifying the seriousness of dealing in lead and the level of risk undertaken in producing and selling it.

Unfortunately, there are no records before the late 1730s regarding lead production or investment. The collection of extant records do, however, offer some evidence as to the nature and form of what appears to have been a mild revival in the late seventeenth and early eighteenth century. Moreover, they offer reasonable proof that the Bowes were amongst those passive estate owners whose inactivity excluded them from the category of land-owning mineral lords who behaved as entrepreneurs during an era of expansion and change in lead production. The chapters that follow will demonstrate that greater commitment and financial involvement came belatedly.

Mining became a growing source of employment, whether part-time or full-time, on the Bowes Estate in Upper Teesdale. Examination of mines pay bills, listing the earnings of 'bargains' for both individuals and groups of miners, do not present great enough detail about the numbers of men and women employed in either actual mining or the washing and dressing of ore before smelting.[7] The ambiguous wording used by field agents who kept these records make it impossible to calculate accurately the numbers employed. For example, there are many entries providing the name of a miner followed by the words 'and partners'. Obviously, the omission of the number of partners means accuracy is out of the question. Historians

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[6] *D/St/B2/142-145,* which have been transcribed by Margaret McCollum of the Department of Palaeography and Diplomatic, Durham University, for which I am eternally grateful.

[7] The 'bargain' was the arrangement or contract to mine lead, between employer and employee, mine owner and mineworker. There were variations on this arrangement. See C.J. Hunt *The Lead Miners of the Northern Pennines in the eighteenth and nineteenth centuries* (Manchester 1970) Chapter 3.

of lead mining consider that a 'bargain' in was anywhere from three to twelve men. Again, this range of how many could be employed in a bargain only allows very broad estimates. There are some documents, however, which do specify names or numbers or both.

A number of points of clarification should be made regarding the nature of the financial documents. Records show expenditure for the lead mines began in the early 1730s, but exist mainly for the 1740s and 1750s. Regrettably, there are no annual figures for each mine. There are a number of possible reasons for the absence of annual statistics: the lack of any prescribed method of record keeping; variations in the ability of agents and stewards to maintain records; mines not being worked; or that documents either did not exist or no longer exist. For example, the financial records for Isabell-mea-Hill mine are quite thorough and detailed for the 1740s in particular, because it was undoubtedly viewed as the most productive and of greatest potential.[8] There are also other records for this mine, by way of general reports and estimates of expenses.[9]

Generally speaking, the accounting year-end was 31st December, but there are documents containing apparently useful data, yet spanning other periods.[10] For example, part years or twelve-month periods not commencing in January. The preparation of expenditure accounts was inconsistent, too; categories and items of expenditure are listed in different ways and in different years. Again, the accounts for Isabell-mea-Hill were written by the same steward for the 1740's and are therefore comparatively consistent and informative. Yet even within the better quality records

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[8] There is a ledger of accounts for the 1740's *D/St/B2/105* which contains excellent detail of all items of expenditure.

[9] *D/St/B2/104* a steward's estimate of expenses for Isabell-mea-Hill.

[10] For accounting practices on the Bowes estate in the eighteenth century see Oldroyd's work cited below p.11.

there can be variations in detail as to the nature of any category of expenditure. So for example, there is no mention of 'day work', wages for casual labour, in the accounts ledger, but in a memorandum entitled 'Charge of Winning Oar at Isabell-mea-Hill 1742' it is mentioned and the precise nature of the work detailed with it.[11] In the same memorandum there is an item of £82-2s-0d for the building of a house near the mine, but it does not appear in the accounts ledger. Obviously, these two documents were written at different times for different reasons, but these inconsistencies can skew the perception of the scale of investment in lead. Lastly, expenditure on stock, tools for example, was treated as a debit together with other variable costs, whereas it may be considered as capital equipment.

Consequently, the expenditure records must be viewed with some caution and money noted as spent in documents other than accounts should be brought into the equation when assessing the extent of George Bowes' financial commitment to lead mining. In this analysis wherever possible other documents have been compared to ledger accounts, and extraordinary items of expenditure have been included if considered to be relevant and appropriate. As has already been seen above, this comparison was readily possible for records regarding the mine at Isabell-mea-Hill, and the same methodology is applied throughout.

Expenditure on the lead mines for the purpose of winning ore includes mainly pay bills for labour, materials, and tools. There is, however, a good spread across three decades which give an indication of the level of commitment to maintaining and developing ore production on the Bowes' estate. The documents examined are largely memoranda and pay bills which generally contain broad categories of expenditure rather than fine detail. Once again, records for Isabell-

[11] *D/St/B2/105* a detailed ledger relating to expenditure and receipts for the mine and mills.

mea-Hill provide greater detail because of the way they were kept.

Correspondence, leases, financial records, maps and plans for the period 1760-1800 are generally of very high quality both in terms of condition and content, and steer the history of lead production into three distinct periods in the years between George Bowes' death in 1760 and Mary Eleanor's in 1800.

Ideally, it would be useful to have a direct comparison with coal production on the Bowes estates in terms of entrepreneurship, management, the production process and profits, and any relationship between the exploitation of coal and lead. This would both enhance the historical context in which lead was exploited and perhaps reveal things of significance, particularly during the George Bowes era. A study of the Bowes family's coal activities is beyond the scope of this thesis; it would require further extensive research in the considerable body of coal business documents which form the largest portion of estate records. Wherever possible, however, comment is made about coal in order to justify good methodological practice.

A survey of the historiography of the lead industry spanning the period from the mid-sixteenth century until the late eighteenth century highlights the absence of work on this particular non-ferrous extractive activity in the Upper Teesdale area of the northern Pennines, which happened to form part of the Bowes family estate. Most studies are regional, largely written by local historians who rely heavily upon the very limited range of academic publications, sometimes based on fieldwork and industrial archaeology, but with a slowly developing tendency to research primary sources. Regardless of form, histories of lead mining, including those about the northeast, are generally biased towards the nineteenth century, perhaps because of the nature and accessibility of records.

R. Burt's *The British Lead Mining Industry* (Redruth 1984) remains the first and only definitive national survey of a subject that has otherwise been largely neglected by economic historians. Lead mining in Teesdale receives some attention, but mainly for the late eighteenth and nineteenth centuries. His most recent contribution, 'The Extractive Industries' in R. Floud & P. Johnson (eds) *The Cambridge Economic History of Modern Britain, Volume I Industrialisation 1700-1860* (CUP 2004) reiterates the need for further academic research into the role of a comparatively underestimated sector of the economy in the process of industrialisation.

The most in depth area study of the lead industry is the longstanding A. Raistrick & B. Jennings' *A History of Lead Mining in the Pennines* (1965) which only refers to Teesdale lead production following the arrival of the London Lead Company in 1771, but offers some detail of the part performed by the Bowes family in the northeast lead industry in the late sixteenth century, especially their status as principal Merchant Adventurers trading out of Newcastle upon Tyne. Raistrick's other publications include 'Lead Mining and Smelting in the Northern Pennines in the eighteenth and nineteenth centuries' in *Proceedings of the University of Durham Philosophical Society* (March 1936), and 'Ore Hearth Lead Smelting in the seventeenth and eighteenth centuries' in *Proceedings of the University of Durham Philosophical Society, X part 7* (1950) which reveal nothing of the industry in Teesdale. His other works focus on lead mining in Yorkshire; essentially that in Wensleydale and Swaledale. C.J Hunt's *The Lead Miners of the Northern Pennines in the eighteenth and nineteenth centuries* (Manchester 1970) is fundamentally a social history of lead mining, paying some attention to economic aspects, such as arrangement for working and methods of payment. Once again, however, the Bowes

estate in Upper Teesdale and the role of family members is absent, which is to be expected because this study is the result of research into the Blackett-Beaumont Papers. Lastly, *The Mines of Yorkshire* (British Mining no.72 Northern Mines Research Society 2003) by M. Gill & R. Burt is a significant statistical work compiling data from a broad range of sources, including the Strathmore Papers.

Most of the works cited here are indebted to K.C. Dunham's examinations of the geology of the North Pennines and the potential for profitable mineral exploitation. His classic volume, *Geology of the Northern Pennine Orefield, vol. I Tyne to Stainmore, Economic Memoirs of the Geological Survey of Great Britain* (HMSO 1948; second edition 1990) identifies mineral deposits, including lead veins, and outlines the history of the mines. This assists in clarifying the process of exploration and discovery on the Bowes estate during the period covered by this thesis in an age when there was no scientific geology only practical knowledge. Dunham's earlier article 'The Production of Galena and Associated Minerals in the Northern Pennines; with Comparative Statistics for Great Britain' in *Transactions of the Institution of Mining and Metallurgy,* LIII (1943-4) does not cast any light on lead production on Bowes land. His predecessors were T. Sopwith who in 1833 wrote *An Account of the Mining District of Alston Moor, Weardale and Teesdale, and* W. Forster, author of *A Treatise on a Section of the Strata from Newcastle upon Tyne to Cross Fell with Remarks on Mineral Veins* (1883). Classics of their time, neither of the two latter works have any pointers for this study. Recently, the work of Dunham and others was collated in *Lead Mining Landscapes of the North Pennines Area of Outstanding Natural Beauty* (Durham County Council 2003).

L. Turnbull's *The History of Lead Mining in the North East of England* (Alnwick 1975; second edition 1987; third revised edition Hexham 2006) is a good

introduction to the subject, with maps and illustrations, drawn from a very restricted collection of secondary sources and apparently a range of primary sources not referred to in the short bibliography. There are several studies devoted to lead mining and smelting in specific parts of the northeast, which have included some discussion of the contributions to the lead industry's development made by certain gentry families. A useful collection of such local studies has been produced by R.A. Fairbairn: *The Mines of Alston Moor* (British Mining no.47 Northern Mines Research Society 1993); *Weardale Mines* (British Mining no.56 Northern Mines Research Society 1996); and *Allendale, Tynedale, and Derwent Lead Mines* (British Mining No.65 Northern Mines Research Society 2000). These are broad, though detailed, histories of mines, mining, and smelting, largely based upon secondary sources supported by some research on original documents held in local record offices. Fairbairn occasionally notes the activities of certain Bowes family members in the narrative of the pre-1700, but it is not his intention to enlarge upon either family entrepreneurship or estate management. His most recent mining history, *The Mines of Upper Teesdale* (British Mining no.77 Northern Mines Research Society 2005) is another narrative of various types of mining, including lead, but again drawing mainly from secondary works, with a smattering of references to the Strathmore Papers.

Studies of the exploitation of lead and the expansion of the lead industry through the lens of the gentry estate in the northeast of England are rare. C. Newman's *The Bowes of Streatlam County Durham: a study of the Politics and Religion of a Sixteenth Century Northern Gentry Family* (unpublished PhD thesis York University 1991) study of the Protestant Bowes family in the sixteenth century focuses on their role as a member of a regional elite serving the Crown during a

period of upheaval in the Church and State.[12] Its theme is politics and religion, largely excluding economic affairs. Indeed as far as the region is concerned there is only M. Hughes' case study of the Blackett-Beaumont family's activities in *Lead, Land and Coal as Sources of Landlord Income in Northumberland and Durham between 1700 and 1850* (unpublished Ph.D. thesis, University of Durham 1963). This makes for a very useful regional comparator because of the large scale of the family's business and its significance in the lead market nexus centred on Newcastle. Unfortunately, it is narrowly directed at estate income to the detriment of other aspects which may have furthered our understanding of the importance of gentry entrepreneurship, estate management of mineral exploitation, and the lead industry in regional industrialisation. C.J. Hunt's volume relies on the Blackett-Beaumont Papers, but does not address the family's role. The other significant organisation in the northeast lead industry, the London Lead Company, has been given its status by A. Raistrick's *Two Centuries of Industrial Welfare: the London (Quaker) Lead Company 1692-1905* (1930), and 'The London Lead Company, 1692-1905' in *Transactions of the Newcomen Society, vol. 14*, (1933-34). This organisation was, of course, a corporate body rather than a family enterprise founded on landownership, but was another near- neighbour competitor. Most recently, D. Oldroyd's *Estates, Enterprise, and Investment at the Dawn of the Industrial Revolution: Estate Management and Accounting in the North East of England, c. 1700-1780* (Ashgate 2003) has successfully drawn together earlier research into three family estates, including the Bowes estate, and argues that their productiveness stemmed from accounting practices. His analysis of the Bowes estate concentrates on its hugely successful coal business.

[12] Dr Newman points to the lack of records relating to estate accounts, financial matters, mining and metallurgical industries.

The chapters that follow examine the Bowes family's relationship with lead between 1550 and 1771. Chapter 2 attempts to establish the roots of this relationship in the sixteenth century; Chapter 3 focuses on the swing to inactivity in the lead business during the first half of the seventeenth century, followed by less passive involvement from the late 1670s into the early eighteenth century. The period of George Bowes patriarchy then becomes the focus of the thesis: Chapter 4 discusses the organisation and management of lead production on the Bowes estate in the mid-eighteenth century; Chapter 5 the development of lead mining; Chapter 6 smelting and related activities; Chapter 7 the lead market and carriage; chapter 8 the role of George Bowes; and Chapter 9 the transitional period between 1760 and 1771 prior to the arrival of the London Lead Company. Throughout these chapters specific questions will be addressed relating to various aspects of Bowes' lead exploitation: the quantity of lead ore and pig lead produced; the market – prices, sales, and trade; finance – the sources of finance and the levels of expenditure; profits; productivity – in terms of ore production, yield of metallic lead from ore, and return on investment; the incidence of technological change; the role of the individual, by comparing with other lead producers in the region, and over time by comparing the roles of different Bowes family members from the mid-sixteenth century until 1771; and estate management and innovation.

Chapter 2: Merchants and Mining: sixteenth century foundations

The Bowes family's association with metal mining, and particularly the extraction of lead, began in the sixteenth century, before mineral bearing lands in Upper Teesdale were granted to Sir George Bowes by Elizabeth I in 1593.[13] Indeed, different members

of the Bowes family were involved in mining not only in the Durham, but also in Scotland, the Lake District, and Derbyshire. During the sixteenth century, non-ferrous metal mining, particularly of lead, tin, and copper, was a developing sector in the British economy, when foreign expertise and technology began to infiltrate the mining industry, and when gentry, nobility and Crown officials supposedly worked hand in glove with the more technically advanced and experienced German experts in the search primarily for silver and gold to meet the bullion shortage.[14] From at least 1550 the Bowes family became involved in lead mining, smelting, and the lead trade. As the lead industry and lead production grew during the second half of the century, and particularly during the years 1580 to 1600, members of the Bowes family became key figures in the lead business in the north east and placed themselves at the forefront of the lead trade in Newcastle. Their experience of metal mining, lead in particular, in a century of market vicissitudes, technological change, state intervention, and reorganisation in the extractive industries, can be considered as the first stage of its ventures into the exploitation of an industrial metallic commodity in the northeastern economy and trade to London and abroad. This background is crucial to the understanding of the Bowes' involvement with lead in the following two centuries,

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[13] *D/St/D13/2/2*. This Sir George Bowes (1593-c.1643) was a member of the Bradley and Biddick-Waterville branch of the family, and possibly a grandson of Sir George Bowes of Streatlam (1527 -1580). For genealogical table in *Streatlam and Gibside: The Bowes and Strathmore Families in County Durham* (Durham County Council 1980) pp. 46-47.

[14] J.W. Gough, *The Rise of the Entrepreneur* (London 1969), p. 147, and B.A. Holderness, *Pre-Industrial England: Economy and Society from 1500-1750* (London 1976) pp. 150-153.

particularly the eighteenth century.

The purpose of this chapter is to substantiate the contention that the Bowes family were directly involved in lead mining, smelting, and trade from the mid-sixteenth century, and that they may have gleaned experience and expertise through association with German mining experts introduced by the Crown to discover precious metals, and in their role as metal mine inspectors during the Elizabethan period. The nature and extent of their role in the production and supply of lead in the northeast will also be assessed.

A brief outline of the significant features of the lead industry and the market for lead are an essential prerequisite to and a contextual framework for a discussion of the relationship between the Bowes family and lead production during the sixteenth century. These include the general state of the industry, including levels of production over time, scale, and technology; the involvement of the Crown and the granting of monopolies; and the market for lead and the factors affecting it.

Lead production during the Middle Ages was insufficient to meet any demand beyond that of local needs, and like copper, gold and silver in the late fifteenth and early sixteenth centuries, was not growing vigorously.[15] The main lead mining areas in this period were the Mendips, Derbyshire, central and north Wales, and Yorkshire. It is generally agreed that Derbyshire became the centre of English lead mining and smelting throughout the sixteenth century.[16] The extraction and smelting of lead was fundamentally a rural and upland industry, largely because of the

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[15] L.F. Salzman, *English Industries in the Middle Ages* (London 1923) p.67; W. Rees, *Industry before the Industrial Revolution* (Cardiff 1968) Vol. I p.133; and J. Blair, & N. Ramsey (eds), *English Medieval Industries* (London 1991), ch. 4, R.F Homer 'Tin, Lead and Pewter'.

[16] C.G.A. Clay, *Economic Expansion and Social Change: England 1500-1700 Vol. II Industry, Trade and Government* (Cambridge 1984) p.57; D. C. Coleman, *The Economy of England 1450-1750* (Oxford 1977) p.82; Gough, *Rise*, p. 133; Holderness, *Pre-Industrial England*, p.102; and for the Derbyshire lead industry in this period see D. Kiernan, *The Derbyshire Lead Industry in the Sixteenth Century* (Derbyshire Record Society 1989).

geology of mineralisation (see map opposite from R. Burt, *The British Lead Mining Industry* [Redruth 1984]).

Lead production was variable and very limited during the fifteenth century, but from the 1490s harbingers of growth appeared.[17] Metal mining and smelting, including lead, began to develop from the beginning of Henry VIII's reign in 1509, rooted in his desire to become independent of European suppliers.[18] By the 1530s England was still only a small lead producer,[19] but lead was a primary export, more valuable than tin and copper.[20] Blanchard has commented that 'The lead industry, barely capable of supplying the needs of domestic consumption in 1400, had by 1500 become a major exporter and by 1600, with an output of 12,000 tons, was one of the world's leading suppliers'.[21] By the 1580s England had become the largest lead producer in the European market.[22] Clay asserts that 'unless existing estimates of production are seriously misleading, the mining and processing of lead seems to have expanded more rapidly than any other form of extractive activity and most forms of manufacturing industry' between 1500 and 1700, and therefore the lead industry witnessing considerable expansion before 1640.[23] There was considerable growth in pig lead output, especially during the last twenty years of the sixteenth century: 625 tons per annum in 1500; 3,200 tons in 1580; and by 1600 12,000 tons.[24] Salzman points to the late Elizabethan period as the time when 'mining, under the auspices of

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[17] W.G. Hoskins, *The Age of Plunder: The England of Henry VIII 1500-1547* (London 1976) p.167.
[18] Rees, *Industry*, Vol. I p.133.
[19] I.S.W. Blanchard 'English lead and the international bullion crisis of the 1550s' in D.C. Coleman & A.H. John (eds.) *Trade, Government, and Economy in Pre-industrial England: essays presented to F.J. Fisher* (London 1976) p. 21.
[20] Coleman, *Industry*, p.45.
[21] I.S.W. Blanchard 'Labour productivity and work psychology in the English mining industry, 1400-1600' in *EcHR 2nd series vol. xxxi no.1* 1978 p.12; D.C. Coleman, *Industry in Tudor and Stuart England* (London 1975) also remarks that lead was a primary export from c.1500, p.45.
[22] Blanchard, 'English Lead', p.21.
[23] Clay, *Economic expansion, Vol. II*, p.57.
[24] Clay, *Economic expansion, Vol. II, p.58*. These statistics are derived from Blanchard, Labour productivity, in Appendix C.

English capitalists and German engineers, took on a fresh lease of life'.[25] Between 1580 and 1600 annual production almost quadrupled,[26] and by way of comparison, over the two centuries 1500-1700 pig-lead output increased forty-five times, but tin only three times.[27] In the sixteenth century pig lead production grew a phenomenal twenty-fold.

What were the salient features of lead production at this time? The main areas of activity were Derbyshire, the Mendips, Wales, and to a lesser extent the northern Pennine fells. The Derbyshire lead industry was the chief contributor throughout the sixteenth century. It was essentially a rural industry and mining was small scale; generally a mine was shallow pits or trenches, up to twenty feet deep; the labour amounted to only five or six miners, most of whom were farmer-miners; and this small-scale production base was largely funded by landowners. Nobility and gentry who owned land were exploiters rather than innovators, with very few exceptions.[28] Blanchard argues that the fundamental reason for the increase in mining output, lead ore, between 1433 and 1597, was the greater number of miners.[29] Clay suggests that the underlying cause of enormous growth in pig-lead, smelted lead, production was technological improvement that reduced costs and improved quality, and that innovation was stimulated by the need to 'counteract the very low prices' after the lead market was saturated by old lead from the dissolution of the monasteries in the 1530s and 1540s.[30] It is held that expert skills and knowledge from Germany attracted by the Government were at the root of innovation.[31] Derbyshire, where

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[25] Salzman, *English Industries*, p. 67.
[26] Blanchard, 'Labour productivity'; a calculation based upon his statistics in Appendix C.
[27] Clay, *Economic expansion, Vol. II*, p.58.
[28] Holderness, *Pre-industrial England*, p. 153.
[29] Blanchard, 'Labour productivity' p.12
[30] Clay, *Economic expansion, Vol. II*, p.57
[31] Mining developments are evidenced in two German works of technical literature of the early sixteenth century: G. Agricola, *De Re Metallica* (1530); Anon, *Eyn Nut lich Bergbuchlin* (c.1500); and anon, *Probierbuchlein* (early sixteenth century, about assaying). There was also V. Biringuccio,

smelters and merchants were also involved in financing lead mining, was the chief beneficiary of the process of technological diffusion from the Mendips and the entrepreneurial and innovative role of the Earl of Shrewsbury, rather than any specific continental source. [32]

The generally received view of the market for lead is that both home and overseas demand spurred the industry to greater levels of output.[33] London was the largest home market for pig lead, [34] followed by the developing industrial areas of the West Midlands and Tyneside.[35] Lead was exported to Spain and France, and re-exported from Spain to the Mediterranean and Central America.[36] Antwerp was the chief recipient and gateway for the distribution of English lead into Northern and Central Europe.[37] Hoskins wrote that English lead was one of Europe's most valuable commodities, and that it monopolised the Western European market during the first half of the sixteenth century.[38] Lead exports in 1564/5 were valued at £26,200.[39] The main lead ports during the sixteenth century were London, Hull, Bristol, and Newcastle, and for a brief period in the early 1550s Hull exported more lead than London.[40] Indeed, one view is that in 1500 Hull, the outlet for lead from Derbyshire and Yorkshire, was the chief lead port.[41]

It has already been noted that lead production was a function of both

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De la Pirotechnia (Venice 1540), a contemporary Italian volume.

[32] Kiernan, *Derbyshire lead*, p.1; Gough, *Rise*, p.134; Clay, *Economic expansion, Vol. II*, p.57; Holderness, *Pre-industrial England*, p.151.

[33] Coleman, *Industry* p.14; J.A. Chartres, *Internal trade in England* (London 1977) p.35; Clay, *Economic expansion, Vol. II*, p.57.

[34] T.S. Willan, *The English coasting trade*, pp.72-74.

[35] Coleman, *Industry*, pp.14; Clay, *Economic expansion, Vol. II*, p. 57.

[36] Blanchard, English Lead, p.22.

[37] I*bid*. p.22 & p.28.

[38] Hoskins, *Age of Plunder*, p.167.

[39] I*bid*, p.185.

[40] Blanchard, English Lead, pp.24-29; Chartres, *Internal Trade*, p.35 also mentions Boston in Lincolnshire, and Chester and Aberdovey on the West Coast.

[41] Clay, *Economic Expansion, Vol. II*, p.108

national and foreign demand. In the early sixteenth century England was an insignificant lead producer; by the end of the century it was a major supplier of lead in a worldwide sense and Europe's main source of supply.[42] The major factor affecting market equilibrium was the huge increase in the supply of lead as a consequence of the dissolution of the monasteries. Prices in the home market fell drastically, and lead production became virtually extinct by the end of the 1530s. In the overseas market cheap English lead was exported mainly to France, Spain, and the Low Countries, and from Spain it was re-exported to the New World and the Mediterranean. The lead export trade shrank in the early 1540s, whilst the Crown held massive stocks which did not disappear until about 1550, and in the meantime, because of the war against France banned exports from 1544. European silver refiners bought cheap English lead, which in turn virtually obliterated Continental lead production. In 1548/9, however, lead exports reached ten times those of the pre-Reformation level. Commercial crises and further Crown restrictions on lead exports damaged trade again in the 1550s, a decline that went on until the mid-1560s. Recovery appears to have begun from the late 1560s, with lead production increasing rapidly between 1580 and 1600 as indicated above.[43]

During the Elizabethan era the search for bullion continued and metal mining became a focus of Crown interest. 'In 1558, and until 1603, Queen Elizabeth paid much attention to the British mines. She sent to Germany, and obtained the services of a large body of practical miners. These were dispersed over the various mining districts of the kingdom, and they introduced a better system of mining, and more perfect processes of dressing the ores. This was especially observable in the

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[42] Blanchard, *English Lead*, p. 21; Blanchard, 'Labour Productivity', p.12; Hoskins, *Age of Plunder*, p.167.

[43] This paragraph is taken from Blanchard, English Lead, pp. 21-29, and Hoskins, *Age of Plunder*, pp. 167 -168.

machinery employed for dressing the ores of tin and lead'.[44] In 1568 two companies were granted royal charters which in effect created monopolies for the production of metals: The Company of Mines Royal, an Anglo-German partnership, essentially for the production of copper in Cumberland, in which the English side was to a large extent fronted by high-ranking state officials; and the Company of Mineral and Battery Works concentrating on iron-plate, brass and bronze, and the manufacture of brass and iron wire, which consisted only of domestic shareholders, and was only one tenth of the size of the Company of Mines Royal. The Governor of the Company of Mines Royal was a German, Daniel Hochstetter, a master miner and smelter from Augsburg.[45] Put bluntly, both these chartered Companies were unsuccessful, but some members of the Bowes family had involvement with the Company of Mines Royal, and this will be discussed below.

Clearly, metal mining, and lead production in particular, experienced growth during the 1500s with lead becoming a staple English export commodity as the century progressed. The Peak District was the focal point of the English lead industry at this time, whilst the Bowes family's activities in lead and other metal mining were conducted mainly in the north of England, but extended to Scotland, Derbyshire, and the Lake District. Therefore, a brief outline of the lead industry and trade in that region is essential to an understanding of the nature and extent of the family's place in both the national and regional scene (see map opposite from A. Raistrick & B. Jennings *A History of Lead mining in the North Pennines* [London

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[44] R. Hunt, *A Historical Sketch of British Mining* (London 1887) p.52. The extent and nature of this foreign influence is not described or evidenced by Hunt.

[45] See M.B. Donald, *Elizabethan Copper: The History of the Company of Mines Royal* (London 1955, reprinted 1994), and M.B. Donald, *Elizabethan Monopolies: The History of the Company of Mineral and Battery Works* (London 1961).

1966]).

Lead was mined in the Alston area, and in the river valleys of the northeast, especially Weardale and Teesdale.[46] Weardale lead mines and smelting saw renewed activity during the Elizabethan period when the demand for lead grew and prices rose.[47] The Bishop of Durham was the biggest owner of lead bearing lands in the northeast;[48] production was carried on largely by lessees in Weardale from the late fourteenth century.[49] The primary market for lead from this region was London from the early fifteenth century. Pig lead was shipped down the Tyne from Swalwell and Whickham and out of Newcastle; smaller amounts from Stockton and Hartlepool.[50] Coal was the most important commodity for the merchants of Newcastle upon Tyne, but lead was always sufficiently valuable to stock when available. It was extracted, smelted, then carried from the northern Pennines to Newcastle, and then shipped to London and overseas.[51] By the early sixteenth century Newcastle monopolised the lead export trade, most lead coming from the Weardale mines, and the balance from Cumberland and Westmoreland.[52] Blanchard estimates Newcastle had 10.5% of the lead export trade in 1548/9, 10.8% in 1551-54, and 12.4% in 1561-64,though the amount of lead it exported fell in line with the general trend from 300

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[46] See Hunt, *British Mining,* pp.148-150. There is evidence of lead mining in Weardale from Roman times, and on Alston Moor from c.1130, see Raistrick & Jennings, *Lead Mining*, p. 8 and p.48; in Teesdale from at least the mid-sixteenth century, Raistrick, *Lead Mining*, p.152, but probably earlier, see J. Pickin, 'Early Lead Smelting in Teesdale', in L. Willies, & D. Cranstone, (eds) *Boles and Smelt Mills* - Report *of a seminar on the history and archaeology of lead smelting* (Historical Metallurgy Society 1992).

[47] P. Bowes, *Weardale: Clearing the Forest* (1990), p.46. See also, N. Rhodes, 'Lead smelting in Weardale', in *Journal of the Weardale Field Society, no.3* (1984) pp. 8-15.

[48] M. James, *Family, Lineage and Civil Society: A study of society, politics, and mentality in the Durham region, 1500-1640* (Oxford 1974) p.30.

[49] See J.L. Drury 'Medieval smelting in County Durham' in Willies & Cranstone, *Boles;* and A. Raistrick & B. Jennings, *A History of Lead Mining in the Pennines* (London 1965) ch. 2.

[50] Bowes, *Weardale*, pp.45-46.

[51] Hoskins, *Age of Plunder*, p.168; T.S. Willan notes that lead was Newcastle's second export after coal in this period, *Studies In Elizabethan Foreign Trade* (Manchester 1959) p.60.

[52] Hoskins, ibid. p.201. Clay, *Economic Expansion*, p.108, cites Hull as the leading lead port c.1500.

tons, to 120 tons, to 54 tons respectively.[53]

The lead industry of the northern Pennines during the sixteenth century displayed a number of basic characteristics. Lead mining technology comprised of muscle power, waterpower, and simple tools, and the labour force generally consisted of farmer-miners. Smelting was done in boles, which proved quite efficient in terms of the yield of pig lead from ore, but the turnbole came into more general use from the late fourteenth century.[54] In Weardale from the 1460s the Durham oven facilitated an increase in productivity, and from the 1530s the introduction of the ore hearth from Mendip produced slag that could be re-smelted in the Durham oven. In other words, the resultant improvement in productivity arose from the marriage of two technologies, which in turn allowed medieval mines to be re-worked when they would have otherwise remained unviable. The technology of refining lead changed in this period, but not that of extraction; the technological condition of the lead industry remained unchanged until at least the mid-seventeenth century. Lastly, it would appear that during the sixteenth century lead mining and smelting was more expansive and advanced in Weardale than in Teesdale.[55] It was in this setting that the Bowes family delved into lead production and trade.

Having briefly examined the lead industry on a national and regional basis, and before examining the Bowes association with lead in the sixteenth and

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[53] Blanchard, English lead, pp. 24-29.See also, F.J. Fisher, 'Commercial Trends and Policy in Sixteenth Century England', in *E.M. E.M. Carus-Wilson, (ed.), Essays in Economic History* (London 1954) pp. 152-172, and I.S.W. Blanchard 'Commercial crisis and change: Trade and the industrial economy of the North East, 1509-1532' in *Northern History, vol. 8* (1973).

[54] See the glossary of terms for definitions of boles and turnboles.

[55] This paragraph summarising the general condition of the sixteenth century lead industry in the Northern Pennines is gleaned from Raistrick & Jennings, *History, chs. 2 and 3*; I.S.W. Blanchard, 'Lead mining and smelting in Medieval England and Wales', in *D.W. Crossley (ed.) Medieval Industry* (1981); Blanchard, Labour productivity; I.S.W. Blanchard, 'Seigneurial Entrepreneurship; the Bishops of Durham and the Weardale Lead Industry 1406-1529' in *Business History vol. 15* (1973) pp. 97-111; I.S.W. Blanchard 'The miner and the agricultural community in late medieval England' in *AgHR (1972) vol. 20, no.2* pp.93-106.

early seventeenth centuries, it is now helpful to elucidate the entrepreneurial environment in which they became immersed. By the1520s England's transition from a medieval to capitalist economy was well underway, a function of the growth in consumer demand according to some historians, but surely this was only one aspect of a wider process of economic change.[56] During this period, perhaps more so than in the eighteenth century, rural industry was stimulated, and enterprising gentry harnessed under-occupied labour for a range of productive tasks, including the extraction of lead. In areas like the north east of England, where pastoral agriculture required less labour, peasants could become miners, and there was profit available for gentry families with business acumen, like the Vernons in Derbyshire.[57] The gentry invested in a 'wide range of commercial and industrial enterprises', and 'gained a reputation for taking decisive actions to change the world around them in order to make larger profits'.[58] The incomes of the majority of the gentry by the early sixteenth century, however, were rents, but some from office with government or the Crown, although in contrast to the higher aristocracy the 'landed gentry had more of a reputation for enterprise'.[59] Their finances and inheritances were often bolstered by family alliances through marriage.[60]

The Bowes as entrepreneurs were absorbed into a very different context from the mid-sixteenth century when the economic and social landscape was reconfigured by a culture of sponsored economic development. Patronage, at both local and national levels, became a dynamic source of entrepreneurship. The principal manifestation of patronage was various forms of monopoly: delegation of

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[56] See C. Dyer, *Making a Living in the Middle Ages: the People of Britain 850-1520* (Yale 2002), & R. Britnell, *The Commercialisation of English Society 1000-1500* (Manchester 1996).
[57] Dyer, *Making a Living*, p.344.
[58] *Ibid.*
[59] *Ibid*. p.340 and p.343.
[60] *Ibid*. p.341

fiscal rights to collect taxes or duties; patents permitting the overseeing of industry and trade; licenses giving exemption from certain laws; and the granting of an industrial monopoly – for example in mining. A mixture of underlying reasons account for this behaviour: protectionism; the Crown's financial needs; and inducement or payment for the services of the aristocracy and gentry. The participants were the powerful elites, including the higher aristocracy, landed gentry, the Crown, government officials, and merchants. The availability of grants of monopoly to courtiers presented a temptation for businessmen who offered money for countenance at Court to initiate schemes or projects.[61] Thirsk has analysed the promotion of projects conceived by the marriage of cultural ideas and economic policy during the period 1540 to 1630, when economic ventures were launched to provide new occupations and achieve independence from other nations.[62] These projects involved all aspects of industry and agriculture for the 'commonweal', and contributed to the growth of a consumer society, but after 1580 became a source of scandal because of conflicts of interest involving Crown debts, private speculation for profit, and lawsuits, and especially so during the reign of Elizabeth I. At the core of this new business environment was an elite-State axis founded upon the granting of patents of monopoly for the production of a broad range of goods and raw materials. The standard-bearer for these projects was William Cecil, Elizabeth I's Secretary of State, who acted as an economic patron. We will observe below the Bowes connections with monopolies of the time created for the purpose of mineral exploitation, though it is evident that the Bowes were not granted a patent during Elizabeth's reign. Cecil himself invested in mining operations in the Lake District

[61] W.R. Scott, *The Constitution and Finance of English, Scottish and Irish Joint Stock Companies to 1720 (Cambridge 1912) vol I*, pp. 174-176.

[62] J. Thirsk, *Economic Policy and Projects: The Development of a Consumer Society in Early Modern England* (Oxford 1978).

during the 1560s, and was particularly interested in metal mining and refining.[63] Systemic abuse of the practice of granting monopolies, patents, and licenses resulted in its suspension by James 1 in 1603, and the introduction of a commission to review future requests. Francis Bacon, who became interested in monopolies during Elizabeth's reign, was a regular participant in the work of the commissioners.[64]

Francis Bacon's philosophy on the reform of knowledge not only adopted mining as a metaphor for seeking the truth – the truth was 'hydde in certain deep Mynes and Caves – but appears to have directed his views at mining entrepreneurs at the beginning of the Stuart age, perhaps influenced by his father's experience of being a shareholder in the Company of Mineral and Battery Works, shares he inherited in 1579. Bacon's thinking did have practical benefits for those involved in metal mining, and he was closely connected to Thomas Russell, a metallurgical entrepreneur with links to Robert Cecil - Secretary of State and Governor of the Mineral and Battery Works - and the senior personnel at the Royal Mint. The mechanical arts, including mining and smelting, were the focus of Bacon's attempt to convince the upper echelons of society to accept the mutually beneficial relationship between science and labour.[65] The Bowes and others of their ilk had access to Bacon's radical philosophy; they were in the same social class, two members of the Bowes family were commissioned to inspect mines on behalf of the Mineral and Battery Works, and they were present in London and at Court. There are

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[63] See F. Heal, & C. Holmes, 'The Economic Patronage of William Cecil' in P. Croft, *(ed.) Patronage, Culture and Power: The Early Cecils 1558-1612* (London 2002) pp. 199-230. See also, L.S. Stone, *Family and Fortune: Studies in Aristocratic Finance in he Sixteenth and Seventeenth Centuries* (Oxford 1973) Ch. 1.; and L. Stone, 'The Fruits of Office: The case of Robert Cecil, First Earl of Salisbury, 1596-1612', in *F.J. Fisher, (ed) Essays in Economic and Social history of Tudor and Stuart England* (Cambridge 1961) ch.5.

[64] W.H. Price, *The English Patents of Monopoly* (New York 1906) pp. 3-26.

[65] I am very grateful to Cesare Pastorino of the Department of History and Philosophy of Science, Indiana University, for providing a copy of his unpublished paper 'The Mine and the Furnace: Francis Bacon, Thomas Russell, and Early Stuart Mining Culture' delivered at the Thomas Harriot Seminar held at Durham University in December 2008, on which this paragraph is largely based.

scholars who portray Bacon in the role of influential mediator, though not himself a mining entrepreneur, in regular contact with mining experts.[66] Unfortunately there is no firmer evidence at this stage of any contact between Bacon and the Bowes family.

The culture of patronage was rooted in the ideas of political economists and the adverse financial circumstances of Elizabeth I and James I, but there was another, potentially obstructive, aspect to the culture of the period – the clash between 'social convention and market opportunity', ' a tension between the need for wealth to maintain status and the sense that the canons of gentility both demanded certain levels of expense and proscribed certain forms of moneymaking'.[67] Heal & Holmes suggest that this tension between paternalism, characterised by beneficent estate management, and gentry entreneurship, defined by the un-Christian exploitation of tenants, remained until the early seventeenth century but that its intensity was much reduced by 1700 and, in the Bowes case by the mid-eighteenth century, capitalistic behaviour was evident. [68] The harsh realities of a developing market economy served as the breeding ground for the conflict between conscience and coin, because the gentry were confronted with quite rapid inflation between 1500 and 1650, but the apparent opportunity to improve their rentier status was inhibited by slower wage rises and customary tenure on their estates that often prevented enclosure.[69] The alternatives to the improvement of landed estates for profit and increased rental income were activities such as mining and metallurgy, trade and shipping, and urban development, all of which Heal & Holmes define as 'marginal

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[66] See C. Webster, *The Great Instauration: Science, Medicine, and Reform 1626-1660* (London 1975); E. Ash, Power, *Knowledge, and Expertise in Elizabethan England* (London 2004); and D. E. Harkness, *The Jewel House: Elizabethan London and the Scientific Revolution* (London 2007).

[67] F. Heal & C. Holmes, *The Gentry in England and Wales 1500-1700* (London 1994) pp. 100-103.

[68] *Ibid.* p.113. See chapter 4 for the eighteenth century Bowes' behaviour – less paternalistic, more capitalistic.

[69] *Ibid*. pp. 101-105.

and speculative' compared to gentry income from land which was always the basis of their wealth and status.[70] From the early sixteenth century until the outbreak of the Civil War, there were evidently market opportunities for gentry entrepreneurship in estate management for improvement, in metallurgical resources and industry, and in urban development. Certain members of the Bowes family made the passage into mining and related trade at a time when ' traditional assumptions about the impropriety of a gentleman's direct involvement in commerce or usury, or the paternalistic values assumed to govern landlord-tenant relations, had to be reconsidered.'[71]

The Bowes family, well-established Durham landed gentry,[72] seized upon the opportunity for financial gain presented by the existence of lead in Teesdale and Weardale. Their 'connections with the Court and the service of the Crown'[73] was rewarded with lucrative positions. During Henry VIII's reign Sir Robert Bowes was warden of the Middle March and a member of the Council in the North, a member of the Privy Council and Master of the Rolls. The family patriarch held the position of steward of the Crown lordship of Barnard Castle. This extensive influence included an episcopal connection with the Bishop of Durham, from whom opportunities were provided for enrichment and local influence'.[74] Sir Robert Bowes as head of the Bowes family, along with other Durham gentry families, formed an alliance with Bishops who supported the Crown in order to win favour and achieve improvement in their prospects politically, socially, and financially. The Bowes family 'were able and vigorous enough to seize new opportunities' in both metalliferrrous mining and coal

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[70] *Ibid*. pp. 122-128, and p. 135.
[71] *Ibid*, p.135.
[72] James, *Family*, p.30, refers to the Bowes of Streatlam.
[73] *Ibid*. p. 31.
[74] *Ibid*. p. 36. The Bowes were one of the Durham families who held the shrievalty from 1561 until 1608. See also p.151.

mining during the second half of the sixteenth century, including both the Bowes of Streatlam and its younger branch at Biddick.[75]

In 1550 Edward VI granted Sir Robert Bowes and George Bowes 'all that his lead-mines within the New Forest of Teesdale, in the aforesaid bishoprick; all and singular which premises and their appurtenances are scituate, lying, and being within the lordships of Barnard Castle, and within the Forest of Teesdale, in the aforesaid Bishoprick of Durham …….for the term of twenty-one years; paying yearly for the aforesaid mine….forty shillings…. The lead-mine called Flakebrigge, scitiuate, lying, and being within the manor of Egleston……'.[76] After Sir Robert Bowes died in 1555, George Bowes surrendered the lease, and the new lessees were George and William Bowes for the remainder of the term at the same rent.

Flakebrigg lead mine, in the valley of Little Eggleshope Beck, produced ten loads of ore in 1563 at 'ye newe grove in Eglishope', mined by Robert Baynbrig of Frere House near High Force for George Bowes.[77] It seems that some time thereafter the mine fell into the hands of the Earl of Westmoreland, head of the Neville family, and then sequestered by Elizabeth I for his role in the Rising of the North in1569. In 1571 Flakebrigge lead mine was leased to Ralph Bowes for twenty one years at sixty shillings per annum rent and a fine of £6, even though it was 'in great ruin and decay' when surveyed and valued by Robert Bowes [78] and Charles Chaytor on behalf of the Crown.[79] The Bowes family leased this mine again in 1576, when Elizabeth I granted a twenty one year term to Sir George Bowes and

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[75] *Ibid*. pp. 70-71.

[76] Quoted in J. Backhouse, *Upper Teesdale, Past and Present* (London 1896), pp.52-54, and cited in Raistrick & Jennings, *History*, p. 152.

[77] R.A. Fairbairn, *The Mines of Upper Teesdale* (Northern Mines Research Society 2005). Unfortunately, the source of this fact is not cited.

[78] Robert Bowes c.1535-1597, Ambassador to Scotland, treasurer of Berwick, sheriff of Durham, 1562-75. He was also a member of the Council of the North.

[79] Both Backhouse, *Upper Teesdale*, p.54 and Raistrick & Jennings, *History*, p.152 quote this from 13th Eliz. (1571).

his son, describing it as the demesne land of Barnard Castle with the lead mine in the New Forest of Teesdale.[80] 'For the Crown, leases in reversion probably appeared to be an efficient method of regarding royal servants', such leases were essentially for 'the exploitation of the Crown lands for private gain', and 'granted as a form of patronage'.[81]

James has discussed the changing nature of society in the Durham region consequent upon the growing wealth from coal, which led to aspirations for landed status.[82] The process of change in gentry society was facilitated by older, established landed families adopting more enterprising roles in mineral extraction, and especially coal and lead. The Bowes family were in the vanguard of the upper gentry's enterprise in mineral exploitation, with Sir George Bowes leasing lead mines in Teesdale from the Crown, and in Weardale from the Bishop during the latter decades of the sixteenth century.

The bulk of the Bowes lead ore must have come from mines in Weardale where the Bishopric leased mines and mills to a 'Moormaster' who became liable for all costs in involved in production in return for the output, minus a royalty to the Bishop, known as the Bishop's lot, and to the Rector of Stanhope, known as the parson's lot.[83] During the late sixteenth century Sir George Bowes and his eldest son William were the Bishop's Moormasters.[84] It is difficult to specify the exact period during which Bowes family members held the position, or to present any details of the mines and their production, because evidently the Bishop's Auditor's

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[80] Rees, *Industry, vol. II*, p.655.

[81] D. Thomas, 'Leases of Crown lands in the reign of Elizabeth I', in R.W. Hoyle. (ed) *The Estates of the English Crown, 1558-1640* (Cambridge 1992) pp. 183-190.

[82] James, *Family*, ch. 4.

[83] Bowes, *Weardale*, p.47; R.A. Fairbairn, *The Weardale Mines* (Northern Mines Research Society 1996), and A. Blackburn, 'Mining without laws: the origins and practices of the Weardale Moormasters', in T. D. Ford, & L. Willies, *Mining before Powder* (Historical Metallurgy Society 1994) pp. 69-75.

[84] Fairbairn, *Weardale Mines*, p.23, ad Bowes, *Weardale*, p.47

office records were destroyed in 1645.[85]

It is suggested here that there are two possible dates when Sir George Bowes could have become Moormaster, both after the Rising of the North in 1569, when Sir George supported the crown and defended Barnard Castle against the rebels thereby winning royal favour; either 1571 or 1576. The earlier date is plausible because Elizabeth I appears to have rewarded the Bowes family, for their role in the Rising, out of the forfeiture of the Earl of Westmoreland by granting the lead mining lease for Flakebrigg to Ralph Bowes in 1571, and in 1576 granted a new lease for the same mine to Sir George and his son William. The year 1576 is particularly pertinent, because it marked the end of Bishop Pilkington's rule, who did not command the Queen's favour because he demonstrated a lack of leadership and fled Durham during the Rising. This is supported by the fact that Elizabeth I used the occasion of Pilkington's appointment to obtain land from the Bishop's estates, which during a time of financial constraints gave her an additional £700 per annum income.[86] Later the Queen employed the Act of 1571, allowing her to sequester rebel lands following the Rising, to limit his privileges. After his father's death in 1580, the eldest son, Sir William Bowes continued as Moormaster. His lucrative position was undoubtedly bolstered between 1589 and 1595, during the rule of Bishop Hutton, when a daughter of Sir George Bowes married the Bishop's heir. The Bowes were a Protestant family at a time when the Church interest 'stood for a considerable concentration of office, wealth, and influence'.[87] In the case of Sir William Bowes this position probably manifested itself in his role as the leading northeast lead producer. Lastly, it is known that Sir George Bowes died in 1580 and William in 1611, indicating that the family

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[85] *Ibid*.
[86] James, *Family*, p.148.
[87] *Ibid*. p. 151

remained as lessees of the Weardale mines until at least 1611. Therefore, if either of these dates are correct, it would mean that Sir George Bowes and his eldest son William controlled lead mining in Weardale from either 1571 or 1576 until 1611.

The business structure of the Moormaster as in effect the head lessee of the Bishop's lead mines became the prevailing model for the Bowes during the seventeenth and eighteenth centuries on their own lands in Upper Teesdale south of the River Tees. This structure, established before Sir George Bowes held the position, was characterised by sub-letting mines to individuals and small partnerships who were financially liable for lead mining, with the Moormaster as monopsonist. Even more significantly he was completely in control of smelting, the profit centre of the whole structure. The Bishop and the Rector of Stanhope each received one-tenth duty ore, and Bowes retained four-fifths. The Moormaster dominated the whole lead production process but without the burden of risk in lead mining stage, which was sub-let to miners. In complete contrast to other lead mining areas, there was no regulation of any sort, and the miners or individuals or partners who leased the mines had no liberties or recourse against the Moormaster. The discussion below in chapters four to eight of the mid-eighteenth century Bowes' lead business will reveal similarities with that of the late sixteenth and early seventeenth centuries, but also some key differences. More than anything else the initiation of the Bowes into the business of lead production and trade during the late sixteenth century provided, in the form of the institutional Moormaster role, a template for later developments.[88]

During Sir William Bowes' time as Moormaster, he built a water-powered, bellows-blown smelt mill at Burtreeford probably before c.1595, which

[88] Blackburn, Mining, provides detailed analysis of the origins and operational aspects of the Moormaster system pp. 69-75

also received lead ore from Upper Teesdale.[89] We noted above that ore hearth smelting was used in Weardale from the 1530s, married to the Durham oven for slag smelting - the latter technology being a Weardale development according to Blanchard - before construction of the Bowes mill at Burtreeford in Weardale adjacent to the mining areas. It must be assumed therefore, that in Teesdale lead ore was smelted in boles (or bales or bails) with slags smelted in the 'blackwork oven'. There are nineteen known sites in Teesdale entitled 'bail hill', probably more unknown, dating from the twelfth to the sixteenth century.[90] Bowes' building of a technologically up-to-date smelt mill at Burtreeford shifted the focus of smelting to a place higher up the Wear valley amongst the lead mines, and away from Wolsingham which, during the Episcopal exploitation of ores in the fifteenth and early sixteenth century, had developed as the lead smelting centre based on wood fuel from the lower valley hunting forest.[91] It would appear that the economic benefits of a smelt mill at Burtreeford for Bowes mines in Weardale, simultaneously provided a focus for lead ore mined in Teesdale. The customs and practices of the Moormasters date from at least 1566, and in a strict business sense meant that the Bowes owned and operated a smelting business – the profit centre – free from the Bishop's regulation.[92] Consequently, investment in the building of a smelt mill was very worthwhile.

The financial significance of lead to Sir William Bowes is demonstrated by the expansion of his lead interests in the 1590s when he became the owner of a well-established smelting business in Derbyshire. Following the death of

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[89] Fairbairn, *Weardale Mines*, p. 136; N. Rhodes 'Lead smelting'; and Bowes, *Weardale*, p.47

[90] See J. Pickin, 'Early Lead Smelting in Teesdale' in Willies & Cranstone, *Boles.* For the blackwork oven and the Durham oven see Blancha.rd, 'Lead mining and smelting', pp.77-80.

[91] The centralisation of smelting around Wolsingham is noted in J.L. Drury, 'Medieval smelting in County Durham' in Willies & Cranstone, *Boles;* Blanchard, Seigneurial Entrepreneurship; and Blanchard, Commercial Crisis.

[92] See Blackburn, 'Mining', pp.69-70.

Sir Godfrey Foljambe in 1595, Sir William married his widow, which brought into his hands a smelt mill at Walton, near Chesterfield. Subsequently, he owned a wharf on the River Idle at Bawtry, a lead market town frequented by London merchants and their agents, and inland transhipment point in the Derbyshire lead trade. Sir William took the reins of an existing smelting business, one of the few which had adopted ore hearth technology in the 1570s, and Bowes shipped lead from the River Humber mainly to the Billingsgate lead market in London and the rest abroad.[93]

In Weardale, Bowes controlled lead mining under the terms of his lease from the Bishop, which effectively made him the monopoly purchaser of lead ore. The smelt mill at Burtreeford was an improvement technologically, logistically, and in terms of spatial organisation of smelting. The Bowes were leading Newcastle lead merchants from the 1560s. In Derbyshire Bowes became one of the leading smelters and lead merchants in a very different production structure where smelters predominated from the early sixteenth century and consolidated their position so that by the mid-century many were landed gentry. They provided the capital needed for a production process dictated until the 1570s by bole technology – ore purchase, the cost of fuel, and especially for lead carriage to Hull. Moreover, they had the market contacts in London. Kiernan concluded that the old established smelting families, rooted in their bole technology, were disinclined towards commercial expansion in the latter part of the century, because they had achieved landed status from lead income, and formed 'an uncompetitive elite of gentry smelters who controlled every aspect of lead production in the county'.[94] They exhibited a 'social and technological conservatism', they had the economic power to restrict

[93] Kiernan, *Derbyshire Lead*, pp. 211, 223,236, & 247-8. Billingsgate is cited as the chief London lead market after 1564.
[94] *Ibid*. p.266

supply in weaker markets, such as the 1540s and 1550s, and spend time on other activities on their estates. Evidently they exhibited a reluctance to be 'regarded as merchants rather than gentlemen'.[95] Consequently, it must have been extremely difficult, if not impossible to penetrate the Derbyshire lead industry. Sir William Bowes achieved this by marrying the widow of a knightly and leading smelting family whose wealth from lead had expanded their land ownership since the fifteenth century.[96] Although the Foljambes were less resistant to change than most of the Derbyshire smelting oligarchy, Bowes was new blood, possibly introducing a more commercial outlook founded upon his experience of the lead business in the northeast, which included every aspect of the production process, including shipping and trade to London, and his family had been landed gentry since the fourteenth century. Whether it be in Weardale, Teesdale, or Derbyshire, the Bowes involvement in lead production in the late sixteenth century warrants further investigation, probably based upon sources other than those explored for this thesis. Their very active role, and especially that of Sir George Bowes, may prove as significant as that of George Bowes during the mid-eighteenth century.

Sir George Bowes was the chief lead merchant of this period until his death in 1580.The minutes of the Newcastle Merchant Adventurers show that lead was a staple commodity in Newcastle's trade, and that in 1564 the Merchant Adventurers were regulated not to ship lead to foreigners in an attempt to prevent the lead trade becoming controlled by London and foreign merchants.[97] Lead had been for some time 'a cheiff traide and levinge to the bretherynge of this Fellowshype'.[98]

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[95] *Ibid*.
[96] D. Wright, *The Derbyshire Gentry in the Fifteenth Century* (Derbyshire Record Society, 8, 1983) p.12 and p.70.
[97] Raistrick & Jennings, *History*, p. 41.
[98] *Ibid.* Quoted therein.

The value of lead to Bowes and his fellow merchants, and his standing in the lead trade, was confirmed in 1569 when the Merchant Adventurers effected 'An acte conserning Sir George Bowsse's leede',[99] which meant that the Adventurers bought all his lead, which evidently was mined in Allendale as well as Weardale, before apportioning it amongst themselves according to a system of grading within the group. There was a subsequent decree that effectively fined merchants for trading in any other commodity out of Newcastle if they refused to take some of Bowes' lead. In 1572 it was stipulated that any merchant dealing in Bowes lead must share it with other members or be fined. It seems twelve merchants were nominated on behalf of all members to buy from Bowes. Sir George Bowes was clearly the leading supplier of pig lead, and possibly a monopolist, and until new evidence suggests otherwise, his perceived personal contribution should not necessarily be overshadowed by any of his descendants.

In terms of the lead trade in Newcastle there is a dearth of evidence for the late sixteenth century, but some idea of its volume around the turn of the century can be derived from the little there is available. In 1599 the Bowes offered eighty fothers of pig lead to the Merchant Adventurers at £7 13s 4d per fother, and the following year the Bowes supplied another one hundred fothers. At this stage it is reasonable to deduce that the Bowes were probably the principal merchants supplying lead to Newcastle.[100]

The Bowes conducted business with London merchants both in Newcastle and London, and from the late 1560s the Bowes lead business was at certain times financed from London. London was the lead staple, based at Gibson's

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[99] *Ibid*. The details in this paragraph are taken from Rastrick & Jennings.

[100] Raistrick &Jennings, *History*, p. 42, who state Sir George Bowes as the supplier in 1600, but he died in 1580, so it must have been his son Sir William, who was then Moormaster.

Quay, one of the 'legal quays' created following an Act of 1559 which defined the Elizabethan fiscal port of London as part of customs reform instigated by Lord Treasurer Winchester for the benefit of the Crown. This quay was let to William Wiggens in 1582 at a rent of £50 per annum, and thereafter it was known as Wiggens Quay.[101] The organisation of the lead trade in both Newcastle and London, and the Bowes' role are illustrated by a very small collection of documents known as recognizances or bonds drafted and lodged at the High Court of Chancery in London.

Under an agreement of the fourth of December 1567,Thomas Wilbraham advanced Sir George Bowes and his brother Robert Bowes of Barnes £500 for the delivery of eighty fothers of lead at the 'weigh house or beam' in Newcastle in four instalments of twenty fothers on the twenty-fifth of June in each of the four years following. The lead had to be 'good lawful clean and merchantable'. [102] The Bowes agreed to forfeit £1000 if they failed to deliver the lead on time, suggesting that business practice was to agree a recognizance or bond twice the amount of the capital advanced to the supplier(s) who accepted the conditions of the indenture.

In the 1570s dealings with a leading London merchant, Edward Hogan, were fraught with delays in delivering agreed amounts of pig lead.[103] The pertinent recognizance of 14th January 1576 cites details of numerous agreements beginning in 1571 between Sir George Bowes and various partners for the supply of Newcastle lead to Hogan to 'Queen Majesty's beam at the wharf or quay at Gibson's quay'. Partial delivery was not acceptable, although ultimately an agreement was reached for delivery by instalments, but the wording of the document was to ensure

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[101] B. Dietz (ed) *The Port and Trade of Early Elizabethan London Documents* (London Record Society 1972), see pp. ix-x, p.162, and pp. 166-167.

[102] *D/St/B2/142*.The content of this indenture indicates that there was a related document.

[103] Hogan traded with Hamburg, Spain, and Morocco, and was the Queen's ambassador to Morocco in 1577. See Willan, *Studies*, p.148.

Hogan got his lead. At one point Bowes and his partners were in bond to Hogan for £600. Bonds and legal action would only be avoided if Edward Hogan received the lead he ordered, and the negotiated restructuring of the agreements made suggests Hogan was the source of capital advanced to subsidise mining and smelting.[104]

The predominance of London lead merchants and the risks taken by Sir George Bowes and his co-suppliers, Robert Bowes of Aske and his son William, were emphasised when in 1580 they failed to meet a bargain with John Mendam for twenty-four fothers of Newcastle lead which 'long since should have been delivered' to Gibson's Quay in London.[105] Bowes was forced, before the Chief Justice of England, to agree payment of the £400 forfeit in four instalments of £100 each June from 1580,[106] because he had probably received a £200 advance.

The Bowes family and various partners or associates trading lead with London merchants from Newcastle, and occasionally to Hamburg and other European ports,[107] but there was at least one variation in this structure when in March 1593 two other members of the family, Sir William Bowes of Bradley (and of Streatlam, son of Sir George Bowes d. 1580) Henry Bowes of Newcastle, and one Richard Willance, draper, of Richmond, agreed to deliver ten fothers of 'soft merchantable lead in small pigs' by 1st September 1593, to 'the Queen Majesty's beam' Wiggens Quay, London.[108] There is good indication that this lead was produced in Teesdale, because Hartlepool was the shipping port, and the indenture specified 'Hartlepool weight' – twenty hundredweight per fother or 2240 lbs of pig lead.[109] Again, it would appear

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[104] *D/St/B2/143.* This is a somewhat obscure document and I am extremely grateful to Prof. C.W. Brookes of Department of History, Durham University, for his assistance and opinion in clarifying its nature and wording.

[105] *D/St/B2/144.*

[106] These payments were to be made to Michael Boyle, mercer, of London at New Mansion House, Milk Street, London. Perhaps Boyle had discounted Mendam's bond with Bowes and partners

[107] Raistrick & Jennings, *History*, p.42.

[108] *D/St/B2/145*.

[109] A Newcastle fother was twenty-one hundredweight or 2352 lbs, and Stockton was twenty-two

that a London merchant, on this occasion George Bollis, a grocer, advanced monies waiting for delivery of pig lead, and the Bowes would suffer a £120 forfeit for non-delivery.

The members of the Bowes family involved in the lead industry were essentially merchants who also controlled mining and smelting on their leased mining areas, and were principal lead suppliers to the Newcastle Merchant Adventurers. The Bowes and fellow merchants sold lead to London merchants, who often advanced capital which financed the mining, smelting, and carriage of lead to Newcastle, though Hartlepool also played a minor role in the trade.[110] It cannot, of course, be stated for certain that all monies obtained in London were used in lead production. Bowes lead was also an export commodity, either directly to European ports, or via the London market. Lastly, the nature of the documents analysed herein and the sums of money involved confirm that the trade in lead was tightly regulated; contracts were registered at the High Court of the Chancery in London, and failure to comply resulted in the enforcement of forfeits which were usually twice the amount advanced by London merchants.

Is it possible to assess the Bowes contribution to either local and/or national lead production? The lack of statistical information prevents even a poor estimate of their contribution to both local and national pig lead output, and is hampered by the absence of a chronological series, or statistics from different sources which could either be compared or cobbled together to form one acceptable body of statistics for lead output in this period. Most available information is in the form of trade statistics based on the research of Blanchard, Raistrick, Kiernan, and Hoskins.

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hundredweight or 2464 lbs.

[110] Willan, *Studies*, p.69 notes that Hartlepool exported lead to the Continent.

In 1567 the Bowes agreed to supply at least 20 fothers per annum for the next four years; equivalent to thirty-nine per cent of the average annual amount for the period 1561-4 shipped out of Newcastle, and almost five per cent of the average amount shipped out of English ports.[111] It should be noted that the 1567 agreement was only for one purchaser. In 1593 the Bowes agreed to deliver ten fothers to one London merchant, or just over two per cent of the total fothers shipped out of Newcastle but again the ten fothers was only one transaction. By way of comparison with another landed gentry family whose fortunes were deeply interwoven with lead, in 1585 George Talbot 6th Earl of Shrewsbury, and evidently the leading lead entrepreneur of the sixteenth century, smelted 100 fothers of lead.[112] Unfortunately, there is no figure for Bowes production in or around the same year, although there was a contractual agreement to deliver twenty-four fothers to a London merchant in 1580, which they failed to meet.

There is a more useful measurement of the Bowes' prowess in the northeastern lead industry at the end of the sixteenth century. In 1599 Bowes supplied 80 fothers of pig lead to the Newcastle market, and 100 fothers in 1600.[113] In 1601 Newcastle shipped out 59 ¼ fothers of lead, equivalent to 1.48% of the total of 4,006 ¼.[114] Therefore, the amount of lead supplied by the Bowes in 1599 and 1600 exceeded the level of exported lead in 1601. Again, a useful comparison can be made with the Talbots in Derbyshire; they smelted in excess of 240 fothers of lead in 1600.[115] The Bowes weight of 100 fothers supplied was approximately 42% of the estimated Talbot output of pig lead.

In summary, it is possible to give a broad indication of the Bowes trade

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[111] The statistic for 1561-4 is taken from Blanchard, 'English lead', pp. 24-29.
[112] Gough, *Rise*, p.134, and Holderness, *Pre-industrial England*, p.151.
[113] Rastrick & Jennings, *History*, p.42.
[114] Kiernan, *Derbyshire Lead*, p.224
[115] Gough, *Rise*, p.134, and Holderness, *Pre-industrial England*, p.151.

in lead, but the actual output cannot be extrapolated in any meaningful way from the extremely restricted sources. It can be said that, because the Bowes controlled the productive Weardale lead mines and the smelting operations for approximately forty years, the amount of pig lead produced must have been considerably more than the very few recorded amounts supplied to the Newcastle market or exported down the cost to London.

The Bowes family had established themselves at the forefront of the growth in lead production from the late 1560s in response to greater demand both in the domestic market and from overseas, and their involvement must have continued both in the northeast and Derbyshire until Sir William's died in 1611. Certain members of the Biddick branch of the family, however, were involved in the search for gold and silver instigated by the Crown and politicians. This deserves brief mention, because it demonstrates the knowledge and experience they had in mining, and the esteem in which they were held by the Crown for these attributes in the hunt for bullion at the turn of the century. It also reveals their involvement with German mining and smelting specialists with whom the Crown and Government had consorted with since the late fifteenth century, but to little avail, in an attempt to discover and extract precious metals and relieve the shortage of bullion.

George Bowes of Biddick, third son of Sir George Bowes of Streatlam (d. 1580) who was Moormaster of the Bishop's lead mines, was a member of the Privy Council and Marshal to Queen Elizabeth I. He and his younger brother Robert were recognised coal mining entrepreneurs in the lower Wear valley,[116] and George Bowes utilised his coal mining knowledge as part of a three-man commission

[116] J. Hatcher, *The History of the British Coal Industry, Volume I Before 1700 Towards the Age of Coal* (Oxford 1993) p.254, and James, *Family*, pp 70-71.

appointed in 1600 to investigate the state of the Lake District mines focused around Keswick, and exercise repeated in 1602.[117] These mines were essentially copper producing, but there was some lead and silver, and after an initial degree of success in the late 1560s had fallen into decline. He visited the mines in April 1600, with his brother Robert and Daniel Hochstetter Jnr., and demonstrated his detailed knowledge in report on the condition of the mines based upon actual inspections and records and inventories.[118] Evidently both reports confirmed lack of progress amounting to financial loss, and implied indictment of the operation the mines under German expertise and skilled labour.

George Bowes' working relationship with Daniel Hochstetter cannot be said to have led to any member of the Bowes family to introduce German mining methods or expertise into lead mining in either the northeast or elsewhere. Hochstetter was a 'thorough business man, much superior to British industrialists of the day, and a very good metallurgist too',[119] but George Bowes and his brother Robert were highly experienced men in the coal industry, and their elder brother, Sir William, leased the Bishop's lead mines as Moormaster, and their father before him. The Bowes' experience of coal and lead in the northeast suggests that existing methods and technology prevailed, that on-going local developments in mineral extraction were probably more significant than any techniques imported from abroad, and that techniques developed in the northeast were available for deployment elsewhere, such as in Scotland. It would appear that if there were a profound German influence it was most likely to have been organisational rather than technological.

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[117] Donald, *Elizabethan Copper*, p.365

[118] During this visit his brother Robert fell from ladder in a mine and died and George Bowes was also badly injured. Hochstetter witnessed this accident. See ibid, p. 365. Gough, *Rise*, p. 15, is incorrect when he states that it was George Bowes who died by accident.

[119] G. Hammersley 'Technique or economy? The Rise and Decline of the English Copper Industry ca. 1550-1660' in *Business History (1977) vol. 15*, p. 4.

For example, George Bowes extended his mining activities into Scotland when he was appointed by James I's Privy Council to find and mine gold in the Wanlock area and sponsored with a Government subsidy of £300 in 1603.[120] Bowes introduced a team of English miners to work alongside the local miners, but whether he found gold is still in question[121]. This shows, however, that he had sufficient faith in the skills and ability of his own miners to organise their migration to Wanlock. Bowes relinquished the mine believing he was insufficiently funded by the Crown.

There may be other records as yet undiscovered or unavailable which would shed more light on the Bowes family's dealings with lead in the sixteenth century. It has been possible to garner evidence from a range of secondary sources, though some of these are the work of historians who have examined materials currently beyond the range of this thesis. The Bowes family performed a leading entrepreneurial function in lead mining, smelting, and trade in the northeast, a role avoided by the Bishop who generally behaved as a rentier, with the exception perhaps of Wolsey and Pilkington. In particular Sir George Bowes and his son Sir William adopted a commercial outlook from the late 1560s, taking the changing market conditions as an opportunity for financial gain. There seems to have been hesitance at this time amongst landowners to venture into the mercantile world, but as Hatcher has remarked 'The Bowes had no such inhibitions, and were heavily involved in both coal and lead-mining'.[122] There is the distinct impression that the Bowes derived a significant income from the lead industry, and although there was serious risk of forfeiture in some transactions, as some records confirm, this does not mean that the

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[120] Gough, *Rise*, p.155. See also Hunt, *Historical Sketch*, p. 171 who states that Bowes received £200 followed by another £300.
[121] Gough, *Ibid*. p.154 and Hunt, *Ibid*. p.172.
[122] Hatcher, *British Coal*, p.254.

Bowes lead production and trade was unsuccessful. Indeed, it is clear that they were the leading lead suppliers to the Newcastle Merchant Adventurers until at least the early seventeenth century, where self-regulation effectively installed them as monopolists. In London, their dealings with lead merchants must place them in the upper echelon of merchants trading in a high value semi-precious metal, which because of home and overseas demand became a staple commodity. Again, the sums of money contained in original documents verifies the Bowes' capacity to obtain cash on the basis of lead production in times of bullion shortage. This, of course, was possible in both Newcastle and London. Sir William Bowes immersion in he Derbyshire lead industry would undoubtedly have furthered the relationship with London merchants and their agents who visited the Bawtry lead market, and simultaneously developed ties with merchants and shippers in Hull.

In the absence of findings regarding the financial aspects of mining, smelting, and trade during this period, there is only a broad indication of the level of production and trade, and the sums of money involved. Apart from the Bowes' mine at Flakebrigg, which is north of the River Tees, it can only be said that the lands acquired by the Bowes in Upper Teesdale, south of the river, provided the mineral rights potential for lead production, but we must conclude that they were not exploited. The absence of organised lead mining is confirmed by the archaeological fieldwork, which has revealed the inactivity in lead smelting south of the Tees compared to that north of the river. [123] It is possible to say that the construction of a water-powered bellows-blown smelt mill for ore hearth smelting at Burtreeford by the

[123] Pickin, 'Early lead smelting', see map on p.26. The two local histories of lead mining in Teesdale provide further confirmation of the growth in both mining and smelting north of the Tees, and focus on the industry in the late eighteenth and nineteenth centuries, see H. L. Beadle, 'The lead smelting mills of Teesdale and district', in *Durham County Local History Society, no. 11* (1969) pp. 2-10, and with J.K. Almond, *Mining and Smelting in Teesdale* (Cleveland Industrial Archaeology Society 1980) pp. 39-48.

Bowes in the late sixteenth century was an improvement in terms of lead refining technology, and a positive development in the organisation of production in Weardale. The pairing of foreigners and their supposed expertise and technology with the Bowes is unlikely. Apart from the Burtreeford smelt mill, boles probably remained in use for some time. Technique and technology in mining were unchanged, The Bowes' management of the leased mines and smelting in Weardale and Teesdale was characterised by small scale mining operations, but with an innovation in smelting, primarily aimed at reducing carriage costs by building the mill near the mines, thereby displacing the centralisation of smelting operations around Wolsingham. The Bowes family members were not unique in their chosen commercial role; other north east gentry were actively engaged in commerce and industry.[124] The Bowes success in the lead trade during the sixteenth century must be primarily credited to business acumen, but their social and political standing in the north, their favour with the Crown, and direct Crown patronage, especially the granting of lands with mineral rights, were undoubtedly significant positive factors influencing the family's commercial and financial elevation. Nevertheless, it was during the sixteenth century that the interplay of these different factors created the foundations upon which, from time to time, Bowes descendants re-built to varying degrees their lead production business.

[124] James, *Family*, and see also D. Newton, *North East England 1569-1625: Governance, Culture, and Identity* (2006).

Chapter 3: Retrogression and Revival: 1611-1711

This chapter will present reasons for the relative inactivity of the Bowes family in lead mining, smelting, and trade, and the changing nature of their role during the period 1611 to 1711 – from lessee entrepreneurs, as the Bishop's Moormasters, to lessor rentiers, as landowners and mineral lords. Indeed, after a half century and more of developing a lucrative business founded upon the Weardale mines, and a virtual monopoly of lead supply via the Merchant Adventurers in the Newcastle trade, their evidently well-established role in the northeast lead industry seems to have fizzled out in the early seventeenth century. The duration of the Bowes leasing and controlling the Bishop of Durham's Weardale lead mines ended in 1611 when Sir William Bowes died, and there followed a period of retrogression extending from 1611 until 1679. The Bowes estate records for the years from 1679 to 1711 do not evidence a revival of a latent business, quite the contrary: the nature of the Bowes interest in lead metamorphosed into an essentially rentier activity in which they acted as lessors of mines, or potential mining areas, on their own lands in Upper Teesdale.[125] Lead production on the Bowes estate in Upper Teesdale later emerged as an incidental industrial activity during the second half of the seventeenth century, and bore no resemblance to the more structured business of the sixteenth or eighteenth centuries.

Before examining the Bowes' involvement with lead during the seventeenth century it is helpful to give an account of the British lead industry as the setting in which they changed from genuine entrepreneurs who had from the 1560s adapted to changing market circumstances for the production of lead as a source of income, to relatively passive landowning gentry. British lead production expanded

[125] *D/St/B2/1-10* inclusive, being leases to various parties.

during the seventeenth century, particularly after 1650, whilst the Bowes' contribution ebbed rather than flowed.

It is widely acknowledged that during the seventeenth century buoyant domestic market demand presented lead producers with an opportunity for profit.[126] Referring to the period from 1650 Coleman commented that the 'consumption of lead almost certainly increased for it was used in a wide range of industries which must have expanded during the period', noting the rebuilding of London after 1666, the growth of provincial towns, and the demand for lead in the manufacture of pewter, paint, pottery, lead shot, coffins, and glass. Hoskins identified the period 1570 to 1640 as one of extensive rebuilding throughout England,[127] although evidence of regional variations points to the period between 1670 and 1720 are particularly marked in the north of England.[128] The upward trend in the building cycle was broken only by the Civil War.' Clearly, the seventeenth century witnessed significant domestic demand for lead because of the growth in construction; approximately one-fifth of English lead production in the 1630s was consumed by 'building, plumbing, and other domestic services'.[129] The Gibside house and estate, which came into the Bowes family through marriage in 1691, itself underwent rebuilding between 1603 and 1620,

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[126] Clay, *Economic Expansion, vol. I,* p. 57; C. Wilson, *England's Apprenticeship 1603-1763* (London 1971) p. 85; and D.C. Coleman, *The Economy of England 1450-1750* (Oxford 1977) p.165.

[127] W.G. Hoskins, 'The Rebuilding of Rural England 1570-1640' in *Past & Present, no.4* (1953) pp. 44-59, and in his *Provincial England: Essays in Social and Economic History* (London 1963) pp. 131 -148. *Clay Economic Expansion, vol. II* also promotes this view.

[128] R. Machin, 'The Great Rebuilding: A Reassessment' in *Past & Present, no.77* (1977) pp.33-56. The on-going research of Dr. A.G Green at Durham University indicates that the views of both Hoskins and Machin are correct, with gentry, yeoman, and merchant class rebuilding in the later sixteenth and early seventeenth centuries, followed by further rebuilding in the later seventeenth century. Also see C. Platt, *The Great Rebuilding of Tudor and Stuart England*, which recognises early and late seventeenth century rebuilding, and A.G. Green, 'The Durham Hearth Tax: Community Politics and Social Relations' in P.S. Barnwell & M.Airs (eds) *Houses and the Hearth Tax: the later Stuarts house and society* (2007), which discusses rebuilding in the northeast.

[129] I. S. W. Blanchard, *Russia's Age of Silver* (London 1989) p. 45.

and again in the 1720s.[130] The rebuilding of wealthier houses was more likely to have consumed more lead, for roofing and water supply; domestic plumbing was increasing during this period. Overseas demand played a lesser role in the seventeenth century compared to the eighteenth century, and with the exception of 1663, lead exports were low in value.[131] The average lead exports value for 1699-1701 was £128,000, yet was the most valuable of the non-ferrous metals exported. Burt, however, suggests that in the 1630s/1640s 'exports of lead probably amounted to 40 or 50 per cent of total output',[132] which implies an even greater market incentive to mine, smelt, and trade lead.

The trade in lead out of the ports of Newcastle and Stockton also confirms the growing level of demand both at home and abroad, because lead exports from both these ports grew during the seventeenth and early eighteenth centuries. In 1638/9 Stockton shipped forty-four and three-quarter fothers of pig lead abroad, five and a half fothers in the costal trade, and received ten and a half fothers from Hull. The net effect was that thirty-nine and three quarter furthers must have been transported to Stockton from the northern Pennine ore fields in Swaledale, Arkengarthdale, and possibly Upper Teesdale.[133] In 1656/6 Stockton sent 201 fothers overseas and 478 in coastal trade; in 1675/6 895 fothers overseas and 334 fothers coastwise.[134] In 1649 Gray recorded coal, salt, grindstones, and salmon but not lead as Newcastle's chief exported commodities.[135] Yet the coastal trade to Scotland alone

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[130] *Streatlam and Gibside*, and M. Wills, *Gibside and the Bowes Family* (Society of Antiquaries of Newcastle upon Tyne 1995).

[131] Clay, *Economic Expansion, vol. II* pp.141-145. See also D. C. Coleman, *Industry in Tudor and Stuart England* (London 1975) p. 45.

[132] R. Burt, 'The transformation of the non-ferrous metals industries in the seventeenth and eighteenth centuries' in *EcHR, XLVIII, I* (1995) p.35.

[133] T. Sowler, *A History of the Town and Borough of Stockton on Tees* (1972) p.305, based on Port Book statistics.

[134] *Ibid*. p.307 and p.317.

[135] W. Gray, *Chorographia or a Survey of Newcastle upon Tyne* (1649)

shows that lead was a regularly shipped commodity; in 1673/4 7,893 fothers of lead were carried by Scottish vessels leaving Newcastle, although Port Book statistics reveal trade in this particular commodity was subject to extreme highs and lows between 1660 and 1720. [136] In 1705 Newcastle's total trade in lead was 2,577 tons and Stockton's was 3,251tons.[137]

The lead industry responded to the growth in demand. Clay has pointed to expansion in the late seventeenth century, and to a significant increase in production before 1640 evidenced by Derbyshire output,[138] based upon technological change from the late sixteenth century. In 1600 output was 12,000 tons per annum; by 1705/6 it was 28,000.[139] The Derbyshire lead industry continued in its role as the main source of pig lead and 'flourished throughout the century ' followed by Mendip and North Yorkshire.[140] By 1600 it was producing in excess of 3,000 fothers per annum; in the 1680s over 10,000.[141] Overall, the nature of growth does not appear to have been smooth. The Derbyshire lead industry experienced an enormous increase in output from the late sixteenth to the mid-seventeenth century, but only expanded further because of the greater capital investment and new technology,[142] whilst in Mendip lead production fell into decline from the 1670s.[143] By 1705/6 lead production was around 28,000 tons,[144] and total exports in 1706 15,679 tons.[145]

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[136] I am very grateful to Matt Greenhall, a Durham University postgraduate doctoral researcher, for statistics he kindly provided from his examination of Port Books held in the National Archive for his thesis 'The Evolution of the British Economy: Anglo-Scottish Trade and Poltical Union, an inter-regional perspective, 1580-1750'.

[137] R. Burt, 'Lead production in England and Wales, 1700-1770' in *EcHR, new series vol. 22, no. 2* p.257.

[138] Clay, *Economic Expansion, vol. II*, p.57.

[139] *Ibid*. p. 58; and Blanchard, *Age of Silver*, pp. 42-49, states British lead output at 4,000 tons per annum in 1610, and only exceeded 12,500 tons in the 1630s.

[140] Wilson, *England's Apprenticeship*, p.85, and Clay, *Economic Expansion, vol. II*, p. 58

[141] Kiernan, *Derbyshire Lead*, p. 1.

[142] Burt, 'Transformation', p. 35.

[143] J.W. Gough, *The Mines of the Mendip* (Newton Abbot 1969) p.112 and p.157.

[144] Burt, 'Lead production', p.265

[145] R. Burt, *The British Lead Mining Industry*, (Redruth, 1984) Appendix D, p.310.

The established view is that the development of the British lead industry in the sixteenth and seventeenth centuries was spawned by landowners. Holderness asserts that 'the chief contribution of the nobility and the gentry to economic development, however, lay in the exploitation of their estates'.[146] Mining and metallurgy based upon mineral wealth were a source of quite often considerable income, but Holderness maintains that, although landowners played a role of 'initiating entrepreneurs' before 1700, 'the nobleman or gentleman as innovators were rare birds'.[147] During the late sixteenth century and until 1640 one rare bird was the Earl of Shrewsbury, probably the leading industrialist of his time across Derbyshire, Shropshire, Staffordshire and Yorkshire in lead, coal, timber, and iron.[148] . Other examples of gentry families who profited from lead were the Eyres of Hassop in Derbyshire, and the Brights of Carbrook in Yorkshire.[149] Evidently, Richard Eyre became renowned for innovation in lead production and his advice in that regard was sought by the Crown. From the mid-sixteenth century, to meet the demand for lead, landowners supplied much of the working and fixed capital for deeper mining, in Wales, Yorkshire, and the north of England, though London-based merchants often ventured to finance the landowners.[150]

In summary, the lead industry of the seventeenth century was characterised by increased output as a consequence of 'significant changes in the organisation and structure of the industry' underpinned by greater capital investment, and technological change. [151] The level of domestic demand presented an opportunity

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146 Holderness, *Pre-industrial England,* p.154.
147 *Ibid*. pp. 153-154.
148 *Ibid.* p.151. Shrewsbury's role is also highlighted by Gough, *Rise*, p. 34, and detailed by Kiernan in *Derbyshire Lead.*
149 Heal & Holmes, *Gentry*, p.122.
150 Clay, *Economic Expansion, vol. II*, p.57.
151 Burt, 'Transformation', p.35

for financial gain, probably enhanced by mid-century overseas demand. In general terms, landed families blessed with lead veins exploited this opening to gain from the extraction of lead. Whether or not taking on the entrepreneurial function is another matter. Yet the Bowes, having been probably leading producers of lead in the northeast during the late sixteenth and early seventeenth century, if not monopolist suppliers to the Newcastle market and thereby playing a national role because of links with the London entrepot, appear to have vacated their position in an expanding market. There are a number questions to address. How and why did this retrogression before 1679 occur? What were the causes of the revival of involvement in the period 1679 to1711? What form did it take, and what determined it?

The Bowes family lost access to the lead mines of Weardale following the death of Sir William Bowes, eldest son of Sir George Bowes of Streatlam by his first marriage, in 1611. Clearly, the cessation of Bowes lead production when the lease for the Weardale lead mines left their hands, and the consequent financial loss, would have been a massive blow to the Bowes family. In the period 1611 to 1624 the Bishop's lead mines cannot be ascribed to any individual or organisation, but in 1624 the Duke of Buckingham was granted a twenty-one year lease of 'all the mines of silver and lead' within a ten mile radius of Muggleswick, which would encompassed a large area of Weardale as well as Blanchland and Derwent lead mines.[152] Buckingham agreed to all liabilities in mining, and adherence to the mines royal by giving the King one-tenth of any silver produced and delivering the remainder to the Mint.

At this point the Bowes, regardless of previous economic, social, and political standing, were out of the running for the lucrative Weardale mines. It is not

[152] Raistrick & Jennings, *History*, pp. 54-55. The then Bishop, Richard Neile, was a close friend of James I, and very much in the King's favour, 'a special relationship of dependence on and obedience to the Crown'; James, *Family*, p.157. Buckingham was also a favourite of the King.

clear at this stage to whom or if, the Bishop appointed a new Moormaster lessee of the Weardale mines, but the impression given is that the lease to the Duke of Buckingham was a substitute for the position of Moormaster. In 1660 Bishop Cosin awarded it to Humphrey Wharton.[153] In 1668 the lease of the lead mines was extended to embrace three lives in the Wharton family so it must be assumed that their lead business was proving at least worthwhile. The Bowes did not become lessees of the Weardale mines again.

The Bowes had been awarded the Forest and Chase of Lune and Teesdale and the Manor of Mickleton by Elizabeth I in1593,[154] whilst the twenty-one year lease of Flakebrig lead mine expired in 1597. The absence of evidence to the contrary leads to the hypothesis that in 1611 there was insufficient knowledge of the Upper Teesdale landscape, and certainly no discovery of lead veins on the scale of the eighteenth century. In any event, if there had been any lead workings in the early seventeenth century in Upper Teesdale it is doubtful that the level of ore production would have anywhere near replaced that from Weardale. Frankly, the Bowes family owned under-explored lead-bearing lands: at this stage it would have meant initiating searches yet investing only a low level of working capital. There is nothing currently to suggest that such a fundamental process being underway on the Bowes estate, but there was some minor lead mining activity in Upper Teesdale in the late 1650s, which is discussed below. Yet despite any foreign skills and knowledge introduced into metal mining during the Elizabethan period, the very limited knowledge of geology in the seventeenth century exonerates, to some extent at least, the Bowes passivity towards lead mining on their lands. Before the mid-seventeenth century 'no independent science of the Earth as such' existed.[155] There was most probably local

[153] Fairbairn, *Weardale Mines*, p. 23.
[154] *D/St/D13/2/2*.
[155] R. Porter, *The Making of Geology: Earth Science in Britain 1660-1815* (Cambridge 1977) p.11.

lore; knowledge of practical mining disseminated orally within and between lead mining regions, but no body of literature, though there was there was some investigation into minerals in Restoration Britain.[156] It could be said that, because of the family's earlier experience of lead's potential, that they were negligent in an estate management sense. Only a short distance away in Westmoreland, Francis Clifford, 4th Earl of Cumberland and his son Henry paid a team of experienced miners for expert advice and the exploration for minerals on Knock Fell, where they discovered lead in 1617. Ultimately, when ironstone was found, he switched to very profitable iron production. The previous Earl, George Clifford, exploited minerals on his Yorkshire estate, which included lead at Grassington mine in Craven. The Cliffords had a 'family tradition of utilising mineral deposits' in Westmoreland going back to the fourteenth century.[157]

Probably the most important reason for the contrasting position of the early seventeenth century is the plain fact that there was not a male heir of age to take on the role of patriarch and possibly proceed with the development of the estate. Unlike a business, gentry economic activity depended upon family and its contingencies. Sir William Bowes died without heirs in 1611, which meant that by entail the estate passed to Sir Talbot Bowes of Streatlam, eldest son of Sir George Bowes by his second marriage, and therefore Sir William's younger half-brother, and Sir George Bowes of Biddick (1593- c.1643), son of George Bowes of Biddick the coal entrepreneur who died in 1606. The latter agreed to dispose of his property in return for a £100 annuity, probably because he inherited his father's wealth from coal and was uninterested or lacked motivation to develop his share of an estate that was

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[156] *Ibid.* pp. 53-54.

[157] R.T. Spence, 'Mining and Smelting by the Cliffords, Earls of Cumberland, in Westmoreland in the early seventeenth century', in *Transactions of the Cumberland & Westmoreland Antiquarian & Archaeological Society, vol. XCI 1991* pp. 101-117.

essentially farmland, and waste and forest. Sir Talbot was born in 1603, and was therefore only eight years old when Sir William died, and he died in1638, again without heirs. His successor was another Sir Talbot (also born in 1603 and died in 1654) and his brother, Thomas. The latter was born in 1607 and died in 1661 or 1664. Thomas married Anne, a daughter of Anthony Maxton, Rector of Wolsingham and Prebend of Durham, with whom he had four sons; it was the fourth son William, born in 1656, who succeeded him, yet again too young to manage the estate. This family misfortune of either no heirs or male inheritors under the age of twenty-one effectively obliterated the Bowes family capacity to nurture a new lead business before 1679. It could be speculated that if Sir William's joint beneficiary in 1611, Sir George Bowes of Biddick, son of a mining entrepreneur, had inherited his father's abilities and taken up the reins of the estate, there may have been the green shoots of a lead business before 1679. Thomas Bowes' apparent ignorance of lead in the mid-seventeenth century is currently inexplicable. Overall, it could be said that the problems experienced by the Bowes family were typical of any landowning family of the late sixteenth and seventeenth centuries seeking to convert its sources of business potential. [158]

The Bowes were one of many gentry families who experienced genetic adversities, though not in extremis. It may be conjectural, but if between 1611 and the1670s' a stronger, healthier, fecund patriarch as opposed to a weaker, unhealthy, sterile, and possibly feckless candidate, had existed, perhaps the Bowes would not have become divorced from the lead industry and trade. In this respect Heal and Holmes made two points of relevance to the Bowes experience: that 'family

[158] L.S. Stone, *The Crisis of the Aristocracy 1558-1641* (Oxford 1965 unabridged edition) p.69 & p.169,
and Heal & Holmes, *Gentry*, p.24, p.26, & p.52.

continuity was at most risk from genetic chance but estates could be lost by the incompetence or misfortune of the occupier'; and that 'to counter the vagaries of fortune therefore, the gentry family depended heavily upon the personality and abilities of its head'.[159]

There is evidence, scanty perhaps, indicating that where a minor male Bowes heir was inhibited because of age from performing the function of patriarch, that a female occasionally stepped into the void as the minor's representative and to protect the interests of the family estate until the heir came of age. When Sir Talbot inherited from Sir William in 1611, his mother Lady Jane Bowes and second wife of Sir George Bowes of Streatlam, acted on his behalf in the estate's lead business. Richard Daines 1614 map of Eggleston shows 'Lady Bowes Leade Mylls'. This suggests that the Bowes continued to be involved in lead production and before Sir Talbot reached his majority in 1624, though maybe smelting rather than mining and smelting, that they were buying in ore either from small scale operations on their own lands or elsewhere, or letting the mill to other mineral owners for rent. Unfortunately, there is no other evidence of the mill's activities. Later, in 1666, the award of lands in 1593 by Elizabeth I was reinforced and expanded by a Bill introduced by Anne Bowes, mother of Sir William Bowes, when he was aged ten.[160] Again, a female acted as guardian in order to protect the family estate, in this case perhaps unwittingly, for the imminent, if relatively subdued, revival of the Bowes interest in lead.

It is likely that had any member of the Bowes family considered re-entry into the lead business the effects of the English Civil war in the northeast

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[159] *Ibid*. p. 26, and p. 52.
[160] *D/St/D13/2/2*

would probably have acted as a strong deterrent. The region succumbed to the needs of the Scottish army, the Tyne was blockaded in 1644, and there were severe outbreaks of the plague. It is difficult, if not impossible, to contemplate the effects on lead production, which was a rural activity, and the lead trade out of Newcastle. There were signs of slow economic recovery after the departure of the Scottish army in 1647, and minor lead mining operations carried on in Weardale when the Scottish army invaded County Durham, but we have already seen that the Bowes were not present there as Moormasters after 1611.[161] The Parliamentary Survey of 1647 listed nine working lead mines and one failed mine, which would have been sub-leases from the Whartons who were Moormasters at this time, and owners of the lead smelt mill in Wolsingham. The Surveyors valued the Bishop's income from lead as £15 per annum based upon mining during the period 1635-47, and intended to extort the Wharton's lease.

The prohibitive effects on metal mining of the ancient concept of 'mines royal' - the Crown right to claim gold, copper, tin, silver, and quicksilver even on private land - and the embodiment of this prerogative in the form of the monopolies granted in to 1568 the Company of Mines Royal and the Company of Mineral and Battery Works are often advanced as a primary reason for owners of mineral rights and mining organisations being reluctant to invest in metal mining until the late seventeenth century. The historian of both these companies, referring to the creation of the Mineral and Battery Work stated that the counties available to 'the new patentees for mining royal metals were those left over from the previous patent'. In other words, the Bowes lands in Upper Teesdale, which were in Yorkshire, fell under the jurisdiction of the Mines Royal, but not under that of the Mineral and Battery

[161] D.A. Kirby, (ed) *The Parliamentary Surveys of the Bishopric of Durham, vol. I* (Surtees Society 1971) pp. xi-xviii and pp.146-176.

Works.[162] Any lands in Durham, leased or owned, would have been covered only by the latter's remit.[163] The Crown was only effectively interested in gold and silver for coinage, but there were no pure gold and silver mines in England, yet silver was generally found with lead which in theory caused complications for the lead mining industry, 'the terror' of the mines royal as William Waller referred to it in 1700.[164] Seventeenth century contemporaries believed that mines royal damaged the lead mining industry, and deterred landowners from investing in the development of lead mining, which in turn meant the Crown lost a source of duty from the trade in lead.[165]

The Bowes' effective retirement from the lead industry before 1679 was not influenced by mines royal, and there are three supporting facts. Firstly, Bowes lands in Upper Teesdale were outside the Mineral and Battery Works regime, so it could not grant leases for lead mining and smelting there.[166] Secondly, the Mines Royal never succeeded in enforcing any claim to minerals in the Bishopric.[167] The exception to this was the lease awarded to the Duke of Buckingham in 1624, which did not directly affect the Bowes' position, other than to exclude them and any other interested parties from obtaining the mineral rights in Weardale. Lastly, the activities of both chartered Companies were suspended during the Civil War.[168] It was noted above that both these chartered Companies failed, nor did they appear to have any real

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[162] Donald, *Elizabethan Monopolies,* p.17.

[163] For a full an detailed discussion of the concept of mines royal an the two Companies see Donald, *Elizabethan Monopolies*, and *Elizabethan Copper*; and Rees, *Industry, vol. II*.

[164] William Waller, *'Some Account of Mines'* (1707).

[165] Rees, *Industry, vol. II,* p.371.

[166] Rees, *Industry, vol. II* p.655.

[167] *Ibid.*

[168] See H.J. Habbakuk, 'The Historical Experience on the Basic Condition of Economic Growth in B.E. Supple, (ed.) *The Experience of Economic Growth: Case Studies in Economic History* (New York 1963), pp. 111-127. Habbakuk, referring to the conflict of privileged position and competitive stimulus, suggests that state sponsored industrial growth determined by political considerations ended with the Civil War.

effect on lead mining in Britain. Moreover, the mines royal prerogative and pre-emption for precious metals, regardless of the existence of the chartered Companies, did not hinder the growth of lead production during this period, because common law and the rights of landowners prevailed.[169] The ineffectiveness of government policy on

the Bowes involvement with lead production adds weight to the conclusion drawn by Nef in his study of industry and government in France and England during the period 1540 to 1640, that the 'policy of granting industrial monopolies interfered less in England than in France with the progress of heavy industry and the rise of industrial capitalism…….mainly because it was much less generally applied'.[170]

The various influences on and causes of the deterioration of the Bowes earlier attachment to the lead business have been discussed, but it may have been that potentially interested members of the family quite simply decided, for basic economic reasons, that lead mining and smelting were both non-viable and risky as sources of income before 1679. Heal & Holmes pointed to lead and other minerals as an alternative source of financial opportunity for the gentry during a time of inflation before 1650 that restricted agricultural development.[171] Some gentry families seized this opportunity, like the Eyres of Hassop in Derbyshire and the Brights of Carbrook in Yorkshire, and benefited from the viability of their lead veins and business acumen.[172] Others misjudged the risks that plagued the lead business, which brought financial ruin for some gentry families. Only a short distance from the Bowes' lands in North Yorkshire, Sir Solomon Swayle's lead mining enterprise in Swaledale failed because lead carriage costs to market made the whole operation non-viable with

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[169] Rees, *Industry, vol II*, pp.368-369.
[170] J.U. Nef, *Industry and Government in France and England 1540-1640* (1940) p. 141. See also J. de Vries, *The Economy in Europe in the Age of Crisis* (1976)
[171] Heal & Holmes, *Gentry*, p. 99, p.101, p.117, and p.122.
[172] *Ibid*.

devastating financial consequences.[173] Another loser in lead was Sir John Wynn, who managed to supply the market but ultimately unprofitably, primarily because of a trade depression in Europe in the early 1620s.[174]

The growing demand for lead both at home and abroad did not entice the Bowes into the market: they were non-participants between 1611 and 1679, whilst the Blackett family were busy trading pig lead to the Low Countries in the 1670s.[175] Any potential for lead mining and smelting on their Upper Teesdale lands remained untapped, and there was no access to any other part of the established lead industry in northeast England. There was no Bowes response to the two periods of higher prices 1610-1615 and 1625-1640 – both higher than 1590-1610 - when European demand shrank, whilst demand from the Latin American silver industry simultaneously expanded.[176] They made no contribution to the prodigious English output of the 1630s. [177] The comparatively undeveloped potential mines on Bowes lands in Upper Teesdale precluded the option of re-opening existing workings in response to market opportunities, and that there was no infrastructure to support it. The systemic causes of the English lead industry's 'crisis conditions' between 1640 and 1670 in Derbyshire, the Mendip, and South Yorkshire – failure to drain mines and restrictive mining laws or customs – were not the cause of inactivity on Bowes lands. [178] Lead mining was insufficiently developed at this stage to incur drainage problems, and if it had existed there is no history of restrictive laws and customs of the type that

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[173] *Ibid*. p.122.
[174] Heal & Holmes *op. cit.* Also see J.D. Gould 'The Trade Depression of the Early 1620s' in *EcHR 2nd series Vol. VII, no. 1* (1954).
[175] 'A Newcastle Lead Merchant's Trade to the Low Countries' in J. Thirsk & J.P. Cooper *17th Century Economic Documents* (Oxford 1972)
[176] Blanchard, *Age of Silver*, pp. 45-46. See graph of lead prices p.46
[177] *Ibid.* calculates English annual output of 12,500 tons, of which a fifth was consumed by the domestic market.
[178] *Ibid*. p.19 and p. 45.

had become institutionalised in other areas.[179] Lastly, lead prices rose steadily after 1650 and peaked in 1670, which brought into production mines beyond the old established areas; 'production in marginal ore fields in Wales, the southwest, and the central and north Pennines became a viable proposition for the first time in more than a century'.[180] Bowes' lead cannot be included amongst the up and coming mining areas; it was not until 1679 that any serious venture was underway on their lands.

As far as the Bowes affair with lead is concerned in the period 1611 to 1679, any potential for exploitation in Upper Teessdale was prevented by the absence of male heirs in the early seventeenth century, minority before the mid-century, and in two cases disinterest. The family's retrogression in the lead market both regionally and nationally were not influenced by the activities of the Mines Royal or Mineral and Battery Works. It could be argued that a change in the Bowes socio-economic standing in the County Palatine after 1611, combined with a temporary decline in the political power of the landed gentry and aristocrats as a consequence of the relationship between Bishop Neile and the Crown, nudged them out of contention for the Weardale lead mines lease or position of Moormaster. In reality, however, the Bowes had lost the most productive lead mines in the region, and then failed to produce males with appropriate hereditary qualities – a shortage of lead in the veins both below and above the soil.

The period from 1679 until the second decade of the eighteenth century were years of mild revival, defined by the management of small- scale potential on the Bowes estate in Upper Teesdale rather than a developmental approach. The Bowes family, with the exception of only one lead mine, were

[179] See Blackburn, 'Mining without Laws'.
[180] Blanchard *op.cit.* p.48.

uninvolved; passive management through the letting of mines prevailed. A different milieu existed after the Interregnum, which facilitated this relatively low-key return to the possibilities of lead as a source of supplementary estate income.

The lack of male heirs with longevity and possessing commercial attributes ended with the birth of Sir William Bowes in 1656. He went up to Trinity College Cambridge, and was admitted to Gray's Inn in the same year 1672. Charles II knighted William in 1684, and in the following year he was made Chief Warden of all the King's Forests and Chases within the Lordship of Barnard Castle, Teesdale and Marwood. Importantly, he had four sons, three of whom succeeded him after his death in 1706. Therefore, in Sir William Bowes the family now benefited from a patriarch who proved a capacity for developing their prosperity, and undoubtedly the most rewarding act was his marriage in 1691 to Elizabeth, granddaughter of Sir George Bowes of Biddick daughter and sole heiress of Sir Francis Blakiston of Gibside, a north County Durham estate well endowed with minerals, coal especially.

During Sir William's time he granted only five leases for lead mines and potential mining areas, and after his death in1706, when his sons were minors, only another three leases were granted. Lead mining on the Bowes estate will be discussed below in detail, suffice to say here that only a lease of 1679, which formed the basis of an initial joint venture with a local smelter, directly involved members of the Bowes family. There was evidently no commitment to discover new and exploit existing lead veins in an organised way; lead production on the Upper Teesdale estate was viewed as a risky, incidental source of income, and its nature was haphazard and intermittent. The Bowes family owned the mineral rights, but apart from the partnership at Green Mines in the Forest of Lune in and an attempt to work Lunehead mine, they were not directly involved in mining to any significant extent either in

their own right or with others.

. In a regional context the Bowes were laggards compared to two other lead mining and smelting operation; the Blacketts and the London Lead Company, the

histories of which have been well documented.[181] Both of these organisations were large scale investors in lead mining and smelting and exhibit the common factor of single company development. The Blacketts, who became the Blackett-Beaumonts as the estate passed down through the family, purchased the Allendale estate from the Fenwick family in 1694, and in 1698 bought the lease of the Weardale mines from the Wharton family, which carried with it the position of the Bishop of Durham's Moormaster. This reaffirms the Bowes family's exclusion from access to Weardale lead after for the second half of the seventeenth century. The London Lead Company can perhaps be seen as having a more national identity because it produced lead in both the Alston area and in Wales after 1704, and during the eighteenth century expanded its activities in the lead industry in Alston, Teesdale, and Derwent. By the second decade of the eighteenth century the Blacketts and the London Lead Company dominated lead production in the north east, with the Bowes conspicuous by their absence.

Although literature on mining was still negligible in the late seventeenth century, the Blackett and London Lead Company enterprises in the same region as the Bowes would suggest that sufficient local knowledge and skills were available had the Bowes intended to explore, discover, and exploit lead on their estate in Upper Teesdale. The Bowes may have been aware of current literature but

[181] A. Raistrick, *Two centuries of industrial Welfare: The London (Quaker) Lead Company 1692-1905* (London 1938); Raistrick, 'The London Lead Company, 1692-1905' in *Transactions of the Newcomen Society, XIV*, pp 119-162 (1935); M. Hughes, *Lead, land and coal as sources of Landlord income between 1700 and 185'* (unpublished Ph.D. thesis University of Durham 1963).

uninterested in lead mining, preferring to devote time and money to other activities.[182] Perhaps they were unmoved by what one historian, in discussing the purpose of this literature, has referred to as 'some strong patriotic mercantilist reasons for gentry investment in mining enterprises'.[183] More likely is that by the late 1600s the Bowes' knowledge of the sparsely inhabited frontier landscape of their north Pennine estate, compared to that of their lower Tees valley Streatlam estate and Gibside to the north, was quite simply far less compelling where mineral rights were concerned.

It has been established that throughout the seventeenth century a market opportunity existed for lead producers, but the Bowes did not exploit it. Sir William Bowes' marriage brought the financial benefits of the Gibside estate together with the Bowes lands, including coal, in south Durham, and coal and iron as sources of income must have distracted him from the riskier option of lead. Gibside's colliery, only four miles from the River Tyne by cost-effective wooden waggonway and linked to London by colliers, was leased to Sir Charles Montagu for rent and royalties. By 1700 it produced around 60,000 tons of coal, on which royalties were based, and the quarterly rent was £122 10s.[184] Any profits from the Wear valley coalmines were in addition to the income from the Gibside lease. Indeed, it could be argued that for the Bowes it was a straightforward matter of opportunity cost; they had knowledge and experience of a valuable mineral – coal – that was in beds and more easily accessible, workable, and therefore low risk, compared to a metal in veins found in strata – lead – for which their experience and knowledge had waned, and therefore was far riskier. Consequently, lead was largely ignored at this point, whereas the known quantity, coal, received consistent attention.[185]

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[182] For example, T. Houghton, *Rara avis in terra* (1681); J. Aubrey, *Chorographia* (1626-97); and T. Hoton, *Some account of mines and the advantage of them to this Kingdom* (1707)

[183] Porter, *Geology*, p.57.

[184] Hatcher, *British Coal*, p.60, p.90, and p.267.

[185] See H. Torrens, *The Practice of British Geology, 1750-1850* (Ashgate 2002) p.1; and Porter,

The extent to which Sir William Bowes earned income from the iron industry can not be quantified here, but there is evidence of his assistance in the resourcing of Ambrose Crowley III's mill at Winlaton, to whom Bowes also supplied charcoal and rented land for the workmen's animals.[186] The impression is that Bowes invested a considerable sum in Crowley's mill for manufacturing iron, but the amount is unknown. Indeed, the connection with Sir William Bowes has been described as 'enigmatic'.[187] Evidently, there were iron mines around Gibside from the time of Sir Ralph Blakiston that were the foundation of the Blakiston family's prosperity and status before coal. [188] Sir William Bowes appears to falls into the category of landowner who played a more entrepreneurial role, by extracting and supplying iron ore to Ambrose Crowley III at a time of growth in iron output which began after 1670.[189] Assuming Bowes still had this raw material on his land and a ready customer in a growing market, involvement in the iron industry could have been perceived as a quicker and less risky source of landlord income when compared to the more costly potential of lead under lands a much greater distance from the River Tyne and the Newcastle market.

The accepted line of argument is that the removal of the Crown's rights over precious metals by the Royal Mines Acts in 1689 and 1693 was a major spur to lead mining, and metal mining in general, from the late seventeenth century onwards, having stifled the development of mining for centuries but in a more serious way from

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Geology, pp. 57-59.

[186] M.W. Flinn, *Men of Iron: The Crowleys in the Early Iron Industry* (Edinburgh 1962), p. 117 and p.26. Winlaton was operational in 1702; see E. Hughes, *North Country Life in the Eighteenth Century: The North East 1700-1750* (London 1952) p.63. Holderness, *Pre-industrial England*, p.150, refers to the role of gentry and nobility in the development of the extraction and processing of iron.

[187] Flinn, *Men*. p.174

[188] Quoted in Hughes, *North Country*, footnote 4 p.63.

[189] *Ibid*. p.99; Clay, Economic expansion, vol. II, p.55; M.W. Flinn, 'The growth of the English iron industry 1660-1760' in *EcHR 2nd series, XI, no.1* (1958).

the sixteenth century. [190] 'Finally in 1693 the Crown abandoned its claim to minerals with a precious metal content, thereby providing a great encouragement to the opening of new mines by removing the fear that they might involve an infringement of the monopoly of the Company of Mines Royal'.[191] In the same way Mines Royal did not interfere with the Bowes involvement with lead before its abolition, similarly its absence evidently had little or no effect immediately thereafter or during the early eighteenth century. The various aspects of the Bowes approach to lead production between 1679 and 1711 will be examined below, suffice to state at this point that the Bowes estate records reveal that only four leases were granted from1679 to1692, and three from 1705 to 1711. Such a tentative foray into the exploitation of mineral rights hardly suggests a positive response to an institutional stimulus; more significantly this gentle revival of interest in lead confirms an almost complete lack of propensity to react to fortuitous market conditions.

Certainly the chronology of the Bowes leases coincides with 'the gracious Act of Royal Mines' that 'quite altered the scene of the mineral world' and changed the outlook of landowners who previously 'endeavoured to conceal their mines, now they labour to find them out'.[192] Four of these leases were granted before 1693, and none were granted between after 1692 until 1705, which is far from indicative of a causal relationship between the extinction of Mines Royal and Bowes lead production. There was probably greater confidence in the lead industry after Act of 1693,[193] but confidence alone did not evoke the crucial decision to become active in

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[190] See T. Hoton, *Some account of mines* (1707); W.J. Lewis, *Lead Mining in Wales* (Cardiff 1967); H. Hamilton, The English Brass and Copper Industries to 1800 (1926); A.K.H. Jenkin, The Cornish Miner (1948); D.B. Barton, *The History of Copper Mining in Cornwall and Devon* (Truro 1961), and *A history of tin mining in Cornwall*, (Truro 1961); Clay, *Economic Expansion, vol. II* p.58; and Rees, *Industry, vol. II* ch.6.

[191] Clay, *Economic Expansion, vol II*, p.58.

[192] The words of contemporary William Waller writing around 1707,quoted in Rees, *Industry, vol. II* p. 371.

[193] Burt, *British Lead*, p.3.

the lead market in an organised fashion similar to the entrepreneurial Bowes of the late sixteenth century. Again, the magnitude of the Blackett family enterprise and the London Lead Company, who burst into life shortly after the Act, put the Bowes' level of activity into perspective – insignificant. Again, their growth cannot be directly correlated to the extinction of Mines Royal; quite simply the increased demand for lead and a willingness to invest in deeper mining and technological advancement were the main reasons for success.[194]

An analysis of metal production during the seventeenth and eighteenth centuries points to the period 1670-1760 as 'a new expansionary phase' in the English lead industry, marked by 'an investment boom' in mining.[195] The underlying causes for this transformation after the period of crisis were a change in mining laws in the 1660s, which effectively removed restrictive practices, and the availability of cheap money in times of limited options for investment.[196] Lead production in the northern Pennines has been referred to as 'marginal' until the introduction of new technology in the late seventeenth and early eighteenth centuries which allowed this area to enjoy the 'mining bonanza' of those years.[197]

Customary laws in any form did not encumber the Bowes, be they liberties, common rights, or ancient customs relating to lead mining. Nor was there any conflict of a political nature between their interests and inhabitants of either their leased or owned lands where the Bowes could benefit from existing mineral rights. This is in complete contrast to other lead mining areas in Derbyshire and Mendip, and tin mining in Devon and Cornwall. In Weardale, from at least 1487, a tradition was established allowing tenants to mine within the Bishop's system; there was no *right* to

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194 Raistrick & Jennings, *History*, p.186.
195 Blanchard, *Age*, pp. 46-48.
196 Blanchard, *Age*, p. 46, and Heal & Holmes, *Gentry*, p. 116.
197 Blanchard, *Age*, p.48.

mine lead. The moormaster role occupied by the Bowes in the late sixteenth and early seventeenth century gave them absolute power to resolve any disputes.[198] During the reign of Charles II, long after the Bowes had lost the position of moormaster, the framework in which lead was extracted remained unchanged.[199] Teesdale lead miners deposed an argument for their freedom to mine based on unwritten 'law' during the reigns of Charles II and William, but the mineral lord defeated their case on the grounds that the right was a privilege, which allowed him to lease the lead bearing lands.[200] Mining customs operating through 'courts' of free miners were usually within

forests and passed down from forest rights. There is evidence of this for lead in Derbyshire, Mendip, on Alston Moor, and in Allendale forest commoners were free miners, but devoid of any 'court' regulation. Teesdale and Weardale were forest areas in this period, but free from mining customs.[201]

On balance, the Bowes' lands were not places where 'conflict developed between the independent miners and smallholders who had traditionally dominated the English extractive industries, and a series of manorial, lords, crown lessees and entrepreneurs who were anxious to capitalise on England's mineral wealth'.[202] The extremely small-scale and intermittent nature of lead workings occupying very few people stultified the evolution of customs and practices found elsewhere. Consequently, if the Bowes had intended to exploit their lead deposits they would not have been confronted with restrictive practices.

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198 Blackburn, 'Mining Without Laws', pp. 72- 74.

199 A. Wood, 'Custom, Identity and Resistance: English Free Miners and Their Law c.1550-1800' in P. Griffiths, A. Fox, & S. Hindle (eds) *The Experience of Authority in Early Modern England* (London 1996) p 260, and footnote 41.

200 *Ibid*. p.266.Unfortunately, no detail is given regarding the geographical area or the landowner. It is most probable that these events occurred north of the River Tees, not on Bowes land.

201 See G. Jones, 'Swanmotes, Woodmotes, and Courts of 'Free Miners'', in J. Langton & G. Jones, (eds) *Forest and Chases of England and Wales c.1500-c.1850* (Oxford 2008) map p. viii, and p.44.

202 Wood, 'Custom', p.252.

Therefore, during the period 1679 to 1711, despite the existence of a conducive institutional framework for metal mining after 1693, and a patriarch who enjoyed a reasonable lifespan, the Bowes did not apply themselves to the exploitation of lead in Upper Teesdale. There is evidence for only one item of working capital, a pay bill totalling £21 10s 8d in 1690 at Lunehead lead mine, and none for fixed capital investment by Sir William.[203] The Blackett and London Lead Company enterprises were large-scale investors in the development of lead mining in the region to meet the demand of an expanding market for lead at home and abroad. Although it cannot be fully explained, the Bowes family employed a strategy of apparently passive estate management by granting a very limited number of leases to essentially local individuals and partnerships who had a low cost speculative interest in lead, but, apart from two lead mines, refrained from serious financial commitment and direct involvement. This was a time of search and discovery, of initial small-scale workings undertaken on the basis of minimum cost.

The level of activity in lead mining and the very limited direct participation from the Bowes family is confirmed by the granting of only seven leases; six to various individuals or partnerships in return for either duty ore or rent, and one involving the family. There are no records of lead-mining production or investment before the late 1730s. This small collection of extant records do, however, offer some evidence as to the nature and form of what appears to have been a mild revival of interest in the potential of lead during the late seventeenth and early eighteenth century. Moreover, they offer reasonable proof that the Bowes were an exception, because their inactivity excluded them from the category of land-owning mineral lords who behaved as entrepreneurs during an era of expansion and change in

[203] *D/St/B2/116* pay bill for Lunehead lead mine.

lead production. The form and characteristics of these leases must be taken as a prerequisite for a comparative analysis that proves the mid-eighteenth century George Bowes regime introduced extensive changes to their nature. The chapters that follow will demonstrate that greater commitment and financial involvement came belatedly.

Sir William Bowes' single venture in lead mining was contained in a twenty-one year lease of 22nd April 1679 for Green Mines between himself, Christopher Wall, and Anne and Jane, two of his daughters.[204] Sir William held a quarter share, his daughters an eighth each, and Wall the incentive of one half. Christopher Wall was very probably the owner of the smelt mill at Bollihope, which he built in 1667 with the permission of the Bishop of Durham.[205] There was no duty ore to the Bowes in this lease; it seems to have been structured on a pay-share arrangement with operations in the hands of Wall as someone regularly involved in the lead industry. The area of ground granted for work at Green mines was 700 yards by 100 yards, which suggests the discovery of lead vein where mining was conducted by hushing and later shafts, and perceived as a potentially good source of lead ore. Hence the Bowes family taking shares in the mine. Lead ore had been extracted from Green Mines late in 1657 by Allan Nicholson under a very short term tack from Sir William, then an infant represented by his mother, suggesting its ease of accessibility.[206] The pig lead produced from this ore was to be delivered to the Bowes for £9 15s per fother.

It is not clear whether or not the Bowes owned a smelt mill during the

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[204] *D/St/B2/3*. The Bowes genealogy suggests Ann and Jane died in infancy, because two daughters of the same names were not born until several years after the date of the lease.

[205] Fairbairn, Weardale Mines, p.135. The Bishop's estate was keen to maximise revenue in the 1660s in order to recover after the Restoration and to fund Bishop Cosin's building projects.

[206] *D/St/B2/1* an agreement between Sir William and Allan Nicholson for the latter to mine and smelt ore between 14th November 1657 and 2nd February 1658.

period in question, which would explain the partnership with the smelter Christopher Walls. There was smelting in Mickleton in 1657/58, because the agreement between Allan Nicholson and Sir William Bowes mentions 'the Blast or ore hearth at Mickleton'. Nicholson was probably the smelter there, because the agreement stipulates he had to smelt the ore into 'Piggs', and that the Bowes were to pay him per fother 'at the said Blast or Hearth'.[207] The existence of a smelter in Mickleton indicates that lead mining was carried on around the mid-century, but to what extent and by whom remains unclear.

Only two lead mines can be identified in the period 1679 to 1711; Green Mines, and at Lunhead where two veins were worked. The only surviving Bowes expenditure recorded is a pay bill for £21 10s 8d for work between 1st June and 3rd November 1690 at the original Lunehead vein. Again, the agreement between Bowes and Nicholson of 1657 permitted the latter to extract lead from Lunehead as well as Green Mines, which confirms at least some exploratory workings at both mines before Sir William began granting leases in 1679. Unfortunately, there are no records of production, miners, or any financial information.

The granting of leases during these years was effectively to consolidate any initial findings and facilitate the enhancement of the Bowes estate by allowing others willing to speculate in lead mining to develop known mines and explore likely areas. Leases were generally granted for either twenty-one years, or for an initial period of up to one year with an option for twenty-one years; this type of arrangement appears to have been standard under 'the Rules of Art & Fathom of Mining'.[208] The Bowes family adopted a long term view of the protection and development of the

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[207] Quoted from *D/St/B2/1*.
[208] Quoted from *D/St/B2/4* lead mine lease from Bowes to various.

estate's potential, and avoided direct involvement unless immediate financial gain seemed likely, for example the abovementioned case of Green Mines. The Bowes estate management of lead was passive, allowing others to exploit their mineral rights.

TABLE 1

List of Leased Lead Mines 1657-1711

Lease date	Term	Lessee(s)	Mine	Duty Ore
1657	2mths	Allen Nicholson	Lune Head	none stated
1679	21yrs	Christopher Wall Anne Bowes Jane Bowes	Green Mines	none stated
1687	1 yr	Allinson's & Co.	Sun Vein (of Lune Head)	none stated
1689	21 yrs	John Morgan	Bradwood Rains	1/7th
1692	21 yrs	John Cowley Matthew Smales Anthony Wharton Nicolas Shields George Featherstone Godfry Myers	Green Mines	1/5th & 5s. p.a.
1705	9mths 21 yr option	Miles Sedgwick	Lunehead (area south east of it)	1/6th
1709	21 yrs	Charles Bainbridge William Blackston Thomas Deane James Bainbridge (all of London)	Lune, Holwick, Lonton	1/7th
1711	1 yr 21 yr option	Robert Allinson Hugh Whitle	Greenfell Common	1/6th

Source: Extracted from *D/St/B2/1-10*

Table 1 above lists the tacks and leases granted from 1657, although the agreement of 1657 with Nicholson cannot be construed as a lease, more a very short term tack permitting lead mining at Green Mines and Lunehead to meet a requirement for pig lead from the Bowes. Other than Green Mines and the two veins at Lunehead, leases were granted for areas allowing liberty to explore and mine where lead was found. Most of the leases contained a clause regarding payment of duty ore to the Bowes lessor, and these ranged from one-seventh to one fifth. Only the lease for 1692 for Green Mines contained a rent in addition to duty ore.

The lessees, as sources of venture capital, originated mainly in the northeast and all but that of 1689 were partnerships. The a lease of 1692, for example, was granted to six partners, one from Newcastle upon Tyne, one from Gilling in North Yorkshire, one from Wolsingham, two from Stanhope, and one from Westgate. The partners from Wolsingham, Stanhope and Westgate resided in the Weardale lead mining area, and must have been aware of the potential of Green Mines. The area lease for Greenfell Common of 1711 was granted to two partners from Barnard Castle and nearby Rokeby. There was interest from London in 1709 when a four-man partnership took a twenty-one year lease on the lead mines in Holwick, Lune, and Lonton, but within months Lady Elizabeth Bowes sought legal opinion regarding repossession for their failure to work the area according to the terms of the lease.[209]

The nature and scale of lead mining on the Bowes lands in Upper Teesdale at the end of the seventeenth and early eighteenth century is divulged by

[209] *D/St/B2/9*, being the legal opinion of Mr Barnes regarding repossession of the mines.

the form of the leases. Green Mines and the original vein at Lunehead were worked by the Bowes and partners, but were just beyond the exploratory stage and therefore small scale. The Lunhead pay bill for 1690 was for only four miners.[210] Green Mines potential had been established and needed working capital to progress from hushing, which must have been the intention of the partners granted a lease in 1692. The two other workings at Lunehead in 1687 and 1705 both commenced on tacks of one year and nine months respectively, which indicate exploratory, very small-scale operations by way of discovery and extraction where possible and easily accessible. Again, the 1711 lease for Greenfell Common began with a one-year tack with an option for twenty-one years subject to finding lead ore where mining was economically viable.

The apparently serious intentions of the London based partnership who were granted a lease in 1709 to mine in Lune, Holwick, and Lonton, proved lacking. Miners' wages were unpaid resulting in cessation of work. The partners proposed to bring in miners from Derbyshire, but there is no indication that migration of labour occurred.[211] That lead mining was very much undeveloped at this stage is further confirmed by an agricultural lease granted for six years on 4th March 1712 by Lady Elizabeth Bowes to Henry Simpson, William Sanderson, and Thomas Atkinson all of Longmartin in Westmoreland, for a farm at Closehouse in Lunedale at an annual rent of £7 5s. This was essentially for pasture but included the words 'Dame Elizabeth Bowes, her Heirs Tenants or farmers liberty of sinking for cole lead or other minerall' and 'with liberty to lead and carry away the same'.[212] This an example of the

farmer/miner being granted the basis for mineral exploration, but reiterates the perception that lead mining on Bowes' land was very marginal in the early

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[210] *D/St/B2/116*
[211] *D/St/B2/9 op.cit.*
[212] *D/St/E3/8/2*

1700s. This indicates a mixed economic activity where the tenants saw lead as a casual cash crop alongside subsistence with a pastoral bias, and provides an illustration of the beginnings in the frontier zone of Upper Teesdale of what Jan de Vries has termed the 'industrious revolution'.[213] The willingness of families who essentially earned a meagre living from marginal upland agriculture to provide labour for lead mining would be later exploited by the Bowes in the mid-eighteenth century.

In summary, during the period 1657 to 1712 there appears to have been a slowly growing appreciation of the value of lead to the Bowes family and an awareness to protect the family's mineral rights, but the use of the mining lease as a tool for governing the methods of extraction and the extent of the mineral lord's involvement, and as the mechanism for controlling the growth and structure of lead production, was evidently limited and certainly not reflective of any business strategy for the expansion of lead production. The tacks and leases were essentially simple and variations in wording evident, but the level of control was lacking, which in turn indicates indifference to managing lead production. Duty ore as a lessor entitlement, measurements for the area of workings, and terms of forfeiture were introduced, but lessees had considerable freedom from Bowes management and there was no template for the growth of a structured lead industry. Throughout the seventeenth and early eighteenth centuries the Bowes family attitude to the management of a lead industry on their land was manifestly passive in nature. The family circumstances that produced this indifference to a potentially lucrative estate activity have been discussed above. This stance appears to have prevailed during the intervening period between the granting of a lease in 1712 and the next in 1738, sixteen years after the commencement of the George Bowes patriarchy.

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[213] J. de Vries, 'The Industrial Revolution and the Industrious Revolution' in *Journal of Economic History, vol. 54, no.2* (June 1994), pp.249-269.

A view has been expressed that lead mining and smelting in Upper Teesdale was the main rural industry from the sixteenth century.[214] This may have been the case north of the River Tees, but on the Bowes estate south of the Tees the development of the lead industry was seemingly well behind other mining areas in the region as well as nationally. This evidence leads us to conclude that the Bowes family did not direct the progress required to reveal the full potential of their mineral rights, and in the late seventeenth century only experimented with lead mining at Green Mines and Lunehead. A lead industry was encouraged in an almost incidental fashion, putting most mining activity in the hands of lessee adventurers, at their own risk, but it is not possible to assess the extent or success of exploratory work, other than to say there was a genuine interest in lead. Perhaps the Bowes family did receive proposals for working lead veins with a view to further development; if so the surviving leases do not indicate significant activity nor do they reveal the level of Bowes' investment other than to suggest that there was a financial commitment in Green Mines on a pay-share basis and very small-scale mining at Lunehead in 1690, but even here there are no details of production or finance. Even in the later seventeenth century it appears the Bowes were reconciled to contemporary economist Nicholas Barbon's view that, in a time of debate about the shortage of silver coin in England, precious and semi-precious metal mining was financially futile.[215]

Lastly, this inquiry into the extent of the Bowes family's relationship with lead during the seventeenth century emphasises the character of some landed gentry who showed reticence in extending their estate activities to include mineral exploitation. Unlike Buckingham in Weardale, they were not the beneficiaries of

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[214] See D. Coggins, *Upper Teesdale: The Archaeology of a Northern Pennine Valley* (1986).
[215] Nicholas Barbon, *A Discourse of Trade* (1696)

patronage, whilst simultaneously suffering the family contingency of being unable to produce either a patriarch or matriarch who may have pursued a riskier approach to the lead business. Hecksher, in his substantial work on mercantilism, quotes an individual who invested much of his money in an effort to obtain a patent or license from which he would derive a good income and lifestyle. In 1618 he succeeded in finding an appropriate niche 'in the supervision of English lead'.[216] The structure of patronage was outlined in the previous chapter; generally a marriage of convenience between courtier and projector, influence and initiator, capital and countenance. The Bowes family appear not to have been amongst those who solicited influential courtiers, consequently there was no fruitful arranged marriage with a candidate who could assist in obtaining patents and licenses for lead.

[216] E.F. Heckscher, *Mercantilism* (London 1935 2 vols.) vol. I, p. 253.

Chapter 4: Management, Mindset, and Monopsony

During the period of George Bowes patriarchy, 1722-60, and for eleven years after his death in 1760, the family held three main estates: two in County Durham, Gibside in the north and Streatlam; and one further south, Wemmergill, in the North Riding of Yorkshire south of the River Tees. Gibside performed two functions: it was George Bowes main residence when not in London, and the operational heart of estate business. George Bowes could not have single-handedly controlled the estate himself, which perforce required two levels of supervision: regularity of visitations by him; and stewards and agents in the field. The management structure for the three estates during the period 1722 until c.1771 was as follows:

At Gibside

1721-1725 Anthony Leaton Snr., senior steward
1734-1770 William Leaton, joint senior steward
1734-1771 Richard Stepehenson, joint senior steward

At Streatlam

1725-c.1755 Thomas Colpitts I, chief steward
c.1755- 1799 Thomas Colpitts II, chief steward

At Wemmergill

Senior stewards and chief stewards as outlined above for Gibside and Streatlam plus

1741-1761 Nathan Horne, mine manager (or 'grove steward')
1761-c.1771 John Bourn
1756-c.1771 John Gibson, smelt mill manager

There are several points of clarification required regarding the Bowes lead business. The senior stewards at Gibside appear to have been the first stratum of management beneath George Bowes, followed by chief stewards at

Streatlam, which was closer to Wemmergill than Gibside in terms of day-to-day lead operations. There was a third stratum on the Wemmergill estate purely to accommodate the development of lead production: specialists who demonstrated expertise in the different stages of the process. They were professional and salaried, but more senior men oversaw their activities. The lead mines manager or inspector, often referred to as the 'grove steward', reported to a senior steward either at Streatlam, or more usually at Gibside from 1756. Similarly, the smelt mill manager reported to a senior steward at Gibside. The lesser management roles of skilled smelters at Bollihope smelt mill during the 1740s should not be overlooked, because they also reported to Gibside and coordinated carriage from mines and to Newcastle. Information, instructions and enquiries passed between and was shared amongst all personnel; the level of communication was regular and detailed. George Bowes was apt to override the lines of communication when he chose to exert directive authority, so consequently there is evidence of reporting and general correspondence between specialists in the field and Bowes. This was more usual in the 1740s and somewhat less so in the 1750s once the structure was firmly embedded. It has not been possible to disentangle the individual roles and responsibilities of Leaton and Stephenson as joint stewards at Gibside, but the latter was the chief recipient of most if not all of any lead related correspondence and reports. Lastly, the stewards involved in the Bowes lead business were appointed to their overseeing tasks according to their geographic proximity to the Wemmergill estate in Upper Teesdale, whereas the specialists were introduced for their expertise in lead mining and smelting.

This chapter explores three inter-related facets of the lead industry on the Bowes estate in the mid-eighteenth century; management, the mindset of the managers, and management of the monopsony created by tacks and leases. The

Bowes estate management structure, the specialist roles of individuals within it, their levels of authority and discretion, their attitudes, and their creativeness, permit at least a limited analysis of the Bowes' management model in terms of the nature of management – knowledge, training, behavioural management including labour recruitment, use of information and accountancy, degrees of trust –and its role in determining the process of expanding lead production as an estate activity. In this context, a distinction is made between the role of managers and that of George Bowes as entrepreneur. The managers' attitudes, or mindset, can be grasped to some extent, allowing some comment to be made about its consequences for their activities. Lastly, the Bowes' monopoly of demand - a monopsony - for lead ore created by the granting of tacks and leases which reserved the right to purchase it, was the primary focus of those managing lead mining, the carriage of ore, and the accounting for it. The development of the lead mining lease under the Bowes regime was the key instrument in the management of mining, and a comparative analysis of those created before and during the period 1738 to 1760 points to innovation in the estate's ability to contend with problems in managing both input and output in lead production under the direction of George Bowes. Eighteenth century estate management differed from the late sixteenth and early seventeenth centuries in that paternalism appears less prevalent, superseded by an exploitative culture originating in the growth of a market economy. Yet the Bowes estate appears to have retained a degree of social responsibility in its attempt to develop its mineral rights, if nothing else by offering employment opportunities to the estate's inhabitants.[217]

The final management framework that emerged under George Bowes

[217] This is a theme discussed and developed by Heal & Holmes, *Gentry*, ch.3

was characterised by its stability, though Bowes himself seems to have become relatively distant from the lead business in the late 1750s. What was the nature of the stewards' work? How did they conduct it? What was the extent of their influence on the Bowes lead business, and can their contribution be assessed or quantified in some way? Is it possible to uncover their level of creativity? What was the behaviour and mindset of Nathan Horne and John Gibson? Was Bowes' estate management successful? Recently, in his study from a narrow accountancy standpoint of management practices on estates in northeast England during the eighteenth century , Oldroyd argues that the Bowes estate was an example of one 'managed efficiently and productively, as evidenced by the systematic nature of the accounting and management arrangement, and the focus in the accounts on making activities profitable'.[218] It will be suggested here that the management of the lead business to some extent contradicts Oldroyd's conclusion.

There are well-established views regarding management, including estate management and the role of the steward. Pollard's groundbreaking work, the only economic history of management as opposed to entrepreneurship during the process of industrialisation, provides terms of reference for this analysis of Bowes' management of lead production on their estate during the mid-eighteenth century.[219] Pollard identifies the 'estate' as an early form of large-scale enterprise within which a framework of administration and management procedure developed from the late sixteenth century.[220] His examination of the problems of management in the eighteenth

century alludes to the extractive industries as dealing with organisational problems

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[218] D. Oldroyd, *Estates, Enterprise, and Investment at the Dawn of the Industrial Revolution: Estate Management and Accounting in the North East of England, c. 1700-1780* (Ashgate 2007) p.25.

[219] S. Pollard, *The Genesis of Modern Management: A Study of the Industrial Revolution in Great Britain* (London 1965)

[220] *Ibid*. pp. 25-26.

earlier than other industries which were still 'at the handicraft stage', and that 'in many respects mining became a model for other industries'.[221] Pollard suggests a direct correlation between the age of an estate and the level of development in management practices.[222] Mingay's study of eighteenth century landed society suggests that the development in estate management was a feature of the general improvement movement, that the management of mineral exploitation as an industrial activity was a natural extension of agrarian change. [223] The rise of the agents and stewards was a feature of a 'commercialized society': men with experience in industry, commerce, and finance, such as William Barker, steward to the Duke of Devonshire, and Thomas Barker, steward to the Duke of Rutland, who together established a mining and smelting business in the Derbyshire lead industry in 1729.[224] Mingay also remarks that management adopted a more thorough, scientific approach during this period, whilst highlighting the role of the land steward.[225] Other historians have since advanced our understanding of the importance of the steward's role.[226]

As far as mining was concerned Pollard concluded that 'mining, in which most of the work was done out of sight, and in which a high degree of technical competence was essential, both for economical working and for safety, was among the earliest to develop a clearly defined management structure' citing lead, tin, and copper mining as exemplars.[227] The origins and development of metal mining

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[221] *Ibid*. pp. 61-62.
[222] Pollard, *Genesis*, p. 27.
[223] G. Mingay, *English Landed Society in the Eighteenth Century* (London 1963) pp. 173-175 and pp. 189-192.
[224] Pollard, *Genesis*, pp. 28-29.
[225] G. Mingay, 'The Eighteenth Century Land Steward' in E.L. Jones & G.E. Mingay, *Land, labour and Population in the Industrial Revolution: Essays presented to J.D. Chambers.* (London 1967) p. 4
[226] See D.R. Hainsworth, *Stewards, Lords and People: the Estate Steward and his World in later Stuart England* (Cambridge 1992), and P. Roebuck, 'Absentee landownership in the late seventeenth and early eighteenth centuries: a neglected factor in English agrarian history', *AgHR* 21 (1973) pp. 1-17.
[227] Pollard, *Genesis*, p. 263 and p. 268.

management, and lead mining in particular, have received little attention in the period before 1800, with the exception perhaps of the London Lead Company. Burt suggests a managerial revolution resulting from the expansion of mining during the eighteenth century, but concentrates his discussion of lead mining management on nineteenth century developments drawing largely on corporate growth in the lead mining sector without reference to estate management as a basis for innovation in lead mining management.[228]

At this stage it has not been possible to identify specific Bowes' estate management practices for lead during the sixteenth and seventeenth centuries, but to the extent that certain family members gained direct experience of German methods, technology and organisation, and of the organisation of the Weardale lead industry as Moormasters, they must have adopted a management strategy of some sort. The English involvement in the Company of Mines Royal in the late sixteenth century, the principal purpose of which was to exploit copper, did not produce a generation of technically trained managers, because the 'mistake was that no amount of observation by a non- technically trained person will make him adequate to take over and develop new ideas', and no 'facilities were provided for what is now called technological education'.[229] The Company of Mineral and Battery Works further illustrates the absence of homegrown management. Put simply, in both cases, there was a failure to absorb foreign methods, little understanding of the minerals and the potential yield, no comprehension of costs and transport, and inadequate supervision, not to mention fraud and bribery, all of which point to lack of appropriate management.[230]

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[228] Burt, *British Lead*, see p. 8 and ch.4.
[229] Donald, *Elizabethan Copper*, p. 3
[230] See D.S. Davis, 'The Records of the Mines Royal and the Mineral and Battery Works', *EcHR* VI (1936), and for examples of dishonesty see W. Pryce, *Mineralogia Cornubiensis* (1778) pp.175-176.

The management structure for the period 1721 to 1771 is outlined above; we can now examine the individuals, their roles, and their levels of influence and creativity in the Bowes' lead business, which will highlight the importance of the individual in the estates' production process. Firstly, by way of background a brief discussion of the estate management structure's *raison d'etre*.

George Bowes was interested in controlling and developing the potential of lead production from mine to market, and his enforced life-style, spending half his time in London and half on his estates in the northeast, dictated the development of a reporting system, albeit a simple chain of command, which supplied him with specific details of every aspect of the lead business. He demanded regular, detailed information from those in his employ, specifics of the production process at every stage; new finds, trial mines, lessee activities, progress in mining and smelting, when projected deadlines would be met, local road conditions, and financial management. It was the latter aspect which concerned him most, and although he appears to have placed considerable faith in a hard core of men to whom he delegated the task of managing his estates, they were expected to operate and adhere to the system of accounting for income and expenditure, because they actually handled Bowes' money. The lead business was by its very nature risky and, accepting this, awareness of the extent of his financial input was Bowes' prerequisite for speculating, together with detailed knowledge of success in terms of the value of lead produced.

Communication in the form of written reports concerning lead mining and smelting was the other key feature of Bowes management. The management reporting structure was straightforward as far as lead was concerned. The mines steward -'grove steward' was the localism – reported on all events in the field, quite often very detailed and in lead mining parlance; measurements of lead veins, progress

in fathoms worked, the number of men employed and the bargains struck, methods and materials used, estimates of ore mined and its quality, amounts carried to the smelt mills, expected timescales for profitable production, activity at leased mines and whether the lessees were conducting their operations properly and adhering to the terms of their leases - because Bowes made money from duty ore - and advice to his master regarding any of the aforementioned, including views as to the integrity of any prospective lessee adventurer or partner Bowes was considering. The reports also included statistical information about ore mined, carriage to the mill, ore 'resting', and the estimated value of ore both from Bowes' mines and duty ore from lessees. The mines steward was effectively employed as a knowledgeable inspector, quite numerate and literate, often capable of assaying potential lead mines before Bowes decided upon the extent of his involvement. George Bowes knew the value of this role and the information and knowledge he could derive from it. Generally, the mine steward's reports were sent to a senior steward whose brief it was to ensure the reporting process was regular and not intermittent, and provided the appropriate information in sufficient detail, because in Bowes' absence the senior steward was authorised to act on his behalf. In certain circumstances, however, the mines steward did report direct to Bowes.

The mines steward also drew up accounts for income and expenditure at the mines, both owned and leased, and generally kept vouchers to evidence these accounts to the senior estate steward who audited them annually before they were signed off as agreed by both parties. This was to ensure that Bowes did not suffer loss, and was a system of monitoring the trust put in stewards was warranted, because they were entrusted with cash. Adventurers who leased mines from George Bowes were required to partake of the agency service offered by their mineral lord, which took the

form of inspections, advice and guidance, and accountancy. They paid for this service, which was obviously more for Bowes' benefit than theirs.

The regular and consistent use of information, its collection centralised at Gibside, demonstrates that the management of lead on the Bowes estate had a professional quality. Most of the reports were written, and usually carried by a lower ranking agent to the estate office for the attention of the senior steward and George Bowes. Occasionally, the mines steward would have a face-to-face meeting with the senior steward to discuss the state of the mines. At all times the role of the senior steward was to oversee progress and to pressure the mines steward to drive mining operations, at the same time managing his main tasks.

George Bowes could not have attained the level of control he desired over lead production without consistent reporting; it was a means of managing an estate activity that he raised from negligible to potentially profitable. Throughout his patriarchy the same basic structure of management and reporting remained in situ. George Bowes' order of the early 1740s, 'Mill & Grove to exchange weekly accounts of oar' which established the information flow, at times became the source of disagreements between the mines steward and the smelt mill manager, and between the mines steward and the senior steward, who all sought George Bowes' approval for their work and opinions.[231]

There were a number of leading players in the Bowes lead industry during the 1740s and 1750s. Undoubtedly the key role was that of George Bowes himself. He was not a landed gentleman sitting idly by watching the exploitation of a valuable mineral develop in haphazard fashion. He directed the process, and in doing

[231] *D/St/ B2/135 (12-13)* his memorandum.

so established the structure of the lead industry in rural Upper Teesdale, whence its product was distributed across the region to Newcastle and beyond. His personal involvement is explored in detail below. Estate documents reveal the others as Nathan Horn, John Gibson who established themselves as the specialists in the field, Thomas Colpitts I, and Richard Stephenson.

. Nathan Horn became field agent for Lunehead mines in 1741 and was paid a salary of £10 per annum.[232] Horn became the Bowes mines manager or grove steward in 1742 and remained so throughout the George Bowes era. In fact, Horn initially played second fiddle to James Raine who was field agent at Isabell-mea-Hill in 1741 and received a salary of £20 per annum. Raine's role at Isabell-mae-Hill was clearly of greater importance to Bowes' plans for expanding lead mining ore, yet somehow Horn became lead mines steward. Nathan Horn had knowledge of mining, and particularly explosives, and his first management project was to develop the workings at Isabell-mea-Hill, but he soon became involved in general management of the mines as a resource available to lessees to assist in mining methods and ore production. This was often noted in mine accounts as 'agency', but in practice was overseeing to ensure that the terms of leases were met and that George Bowes' plans were followed at both his own mines and those of lessees. Horn's opinions appear to have carried considerable influence with both George Bowes and his senior stewards, because his experience and knowledge were rooted in. hands-on management on the orefield and actually in the lead mines. Horn was a Teesdale man – his reports often contained words spelt in Teesdale dialect – but there is no evidence that Horn was a product of the Bowes estate management structure; it is most likely that he acquired his skills and knowledge from working in the lead industry elsewhere in the

[232] *D/St/B2/103* miscellaneous accounts for mines and mills 1741-6.

North East before mining lead on the Bowes estate.

Two senior stewards were also main characters. Thomas Colpitts I whose knowledge of landscape, lead mining, and geology is noted above. He was based at Streatlam and reported on existing mines, but also had the additional function of exploring for new lead veins. His son, Thomas Colpitts II, succeeded him in 1755. The other senior steward was Richard Stephenson, based at Gibside during the 1750s, to whom the mines steward and smelt mill manager reported, He acted as an interface between Bowes and the specialists working in Upper Teesdale. The indications are that Colpitts and Stephenson were products of the Bowes estate system.

John Gibson managed the mill at Wemmergill from outset in 1757. He was well-educated, and his documents rank as some of the best amongst the extant eighteenth century records examined, being highly detailed and beautifully written. Gibson's abilities as divulged in the range of memoranda, general correspondence, and business reports were of distinctive quality; literate and numerate, with business acumen and an understanding of the lead business, and expert knowledge and skills in assaying and lead smelting. Indeed, of all the managers both in the field and up the line, John Gibson was outstanding in his devotion to and his assessment of the business strategy George Bowes chose for the organisation of lead production. His role as assayer of lead ore and silver at Isabell-mae-Hill, and as management consultant in the planning and construction of Wemmergill smelt mill are discussed further in chapter six below. George Bowes' decision to re-organise the stages of lead production and reduce costs by building a new mill at Wemmergill nearer the mines, and to make it the focal point of financial control and general reporting, required someone of Gibson's calibre to ensure the new business regime operated properly. Experience of lead smelting alone would have been insufficient,

but the exact source of his knowledge and experience is unknown. There is no evidence that he was trained within the Bowes estate management structure, which suggests that, like Horn, he was a product of elsewhere in the regional lead industry. Gibson's role as manager at Wemmergill continued after George Bowes died in 1760, and he remained proactive in offering reasoned assessments of the condition of the Bowes lead industry and how it could be improved. His role, performed at Wemmergill, also included the organisation and accounting for the carriage of smelted lead and ore.

Lastly, there was a category of management which played an important

role in the transitional period of the early 1740s; the smelter managers who preceded

the appearance of lead specialists like Horn and Gibson. The smelt mill and the

connected activities of the carriage of both ore and smelted lead were managed by

the leading smelters. In 1741 James Anderson with Thomas Moses managed the

Bowes smelt mill at Bollihope.[233] *During 1742 and 1743 the smelters and mill*

managers were James Sanderson and Lane Sanderson, possibly brothers or father

and son, who also organised the carriage of ore and pig lead and dealt with basic

business documentation relating to the financial aspects of running the mill, such as expenditure on paying carriers and operational costs as well as the smelters' pay. [234]

[233] *D/St/B2/103* miscellaneous accounts of mines and mills.
[234] *D/St/E3/5/21* Francis O'Neale's account book; and *D/St/ B2/103* miscellaneous accounts.

It should be emphasised that, prior to Bowes' recognition in the early 1740s that his strategy for growing a lead business required personnel with appropriate knowledge and skills, the demarcation of specialist roles was nonexistent. The involvement of certain individuals indicates that their contribution was casual, that only some experience of mining was sufficient for the task in hand. One example was Samuel Bland, a field agent in 1737, who handled pay bills and provided powder for blasting in the mines.[235] Even as late as 1744 William Horn, a miner who was partner in a twenty-one year lease at a mine north of Long Crag, acted on behalf of George Bowes in the granting of a ten-year tack at Closehouse, indeed it appears William Horn wrote it.[236] Leaton, a senior steward for the Bowes, reported on ore and pig lead deliveries to and from Bollihope smelt mill in November 1741.[237] Although most of these men were literate and numerate, some wrote in Teesdale dialect and their reports were very limited in content.

During the 1740s and 1750s, as George Bowes' plans for developing lead production from its latent state into a structured industry were enacted, the two key roles were played by Nathan Horn and John Gibson who together effectively ran a rural industrial process interlocking with the Newcastle market. After 1757, when the financial management, accounting, and reporting became largely centred on the Wemmergill smelt mill, the management styles of Gibson and Horn often clashed in hubristic fashion, particularly on the part of Horn, presenting Richard Stephenson as the senior steward at Gibside, with the awkward role of referee in an industrial setting where both men had important functions, both were held in good esteem, but Horn

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235 *D/St/B2/117* pay bills for Closehouse and Standards mines.
236 *D/St/B2/16 &17*, which contain William Horn's name.
237 *D/St/B2/103* miscellaneous accounts.

was the longer serving yet Gibson, with his greater ability, probably correct. In any event, Bowes mines and smelt mill became better integrated because of the work of Nathan Horne and John Gibson.

Apart from the provision of management information, what other roles did stewards have in lead and is there any indication of their level of discretion in the field? The senior steward had a role in exploration and trial mining on the Bowes estate. Thomas Colpitts I even sought to explore in his own right. In 1741 Colpitts recommended that a Derbyshire partnership, with experience of lead mining in Wales, be permitted to explore his estate in Upper Teesdale. Before Bowes showed serious interest in lead mining Samuel Bland wrote in August 1737, as field agent to his senior steward Thomas Colpitts I, that George Ainsley and partners had offered a hushing trial at Lunehead, to be carried on at their expense with one-seventh of the ore as duty to Bowes. Bland remarked that the trial was worth one-fifth duty ore, but stated that he did not have the authority to grant permission for the trial.[238]

The mines steward and a senior steward in the field were meant to collaborate and ensure progress in the development of lead mining on the Bowes estate, including recruitment of miners. A good example of such work was the discovery of a new mine on Mickle Fell, which Thomas Colpitts I called 'Mea-Hill'. Colpitts and Horn had been sent to inspect the vein discovered by John Dent. Colpitts wrote to confirm 'Nathan Horn & self let a bargain to Matthew Raine of Lower Wemmergill & partner to get 20 Bing of ore Dressed fitt for ye Lead Mill'.[239] Colpitss went to Streatlam on 29th September, and to Gibside on 2nd October to report his findings. The same report notes that £20 was lent to whoever was working Lunehead mine. In February 1741 Horne wrote to Colpitts that 'We have a hoall at

[238] *D/St/C2/1/5* is Samuel Bland's correspondence with Colpitts 20th August 1737.
[239] *D/St/B2/90* memorandum concerning an inspection of a new lead mine with a note of expenses

Lunehead' and that he had made bargains with miners for sinking through limestone at '6s.6d a fathom and 10s 6d.a bing for five fathom driving'.[240]

The role of mines steward was comparatively diversified. In 1741

James Raine, then a mines agent, was sent to West Pitts and into Weardale 'a-buying ore'.[241] Nathan Horn was clearly under instruction to consider buying good quality lead ore wherever it became available in the Pennine ore fields, a practice which continued remained unchanged. In his letter to Stephenson of 12th March 1758 Horn confirmed that he had written to George Bowes telling him that he had travelled into Westmoreland where he "had a preference of buying" some ore, but Bowes did not reply. Horn wrote "if I cannot give this man an answer whether I will buy it or not they will sell it to some other".[242]

Detailed mining progress reports were demanded of mines steward Horn. George Bowes was an avid collector of as such information, especially during the early1740s when the lead mine at Isabell-Meah-Hill attracted him most amongst those where he was completely committed. A report of 23rd December 1741 remarks that this mine was "exceedingly good" and "full of oare above head", and that a level had been driven past the cross-cut shaft with "14 fathoms to go to Raisbeck shaft", and added "its ordered to be followed night and day".[243] The report contains Horn's account of all work at both Isabell-mea-Hill and Lunehead lead mines. The cost of work was noted at £23 1s 6d for the months of September, October, and the first half of November, and that £37 had been paid out on account. On 31stOctober 1749

[240] *D/St/C2/1/5* Horn to Colpitts 10th February 1741
[241] *D/St/B2/103* miscellaneous accounts.
[242] *D/St/C2/3/76 (10),* Horn's letter to Stephenson of 12th March 1758.
[243] *D/St/B2/92 (1)* Report on the lead mines at Isabell-Meah-Hill and Lunehead 23rd December 1741

Nathan Horn wrote to Bowes in London to confirm that work at Isabell-Mea-Hill was going well, that a level was being worked "at 20s per fathom, whilst in the shaft 8s per fathom and 10s per bing of oar".[244] In the same correspondence Horn also commented on the new mine at Crinkle How, where George Bowes was in partnership with Lord Carlisle, that "I hope to cut the vain befoar midsummer day first'.

Nathan Horn provided mine management and inspections reports together with basic financial information about expenditure at the mines, but it was Thomas Colpitts, a senior steward, who was responsible for the more definitive reports. Bowes' assessment of the potential of Crinkle How must have proved difficult, because Colpitts wrote in December 1749 to Lord Carlisle's steward at Castle Howard, saying " I grew a little tired of any longer staying in this dismall part of the world; therefore called in the pay bill from Nathan Horn, and on the 15th instant cleared off every Demand on Crinkle How at that time".[245] In other words, on Bowes' behalf, he made the decision to cease mining, yet contemporaneously provided fine detail of the strata at Crinkle How and believed the lead vein there was "reckonable favourable". Colpitts' authority and influence in lead mining appears to have been greater than that of Nathan Horn at this stage.

Colpitts produced a further and fuller report on Crinkle How and other mines, but did not have the discretion to act. Occasionally, George Bowes was the recipient of bad news and adverse conditions in his lead mining affairs and was required to react accordingly. The detailed, pointed letter from Thomas Colpitts of 15th February 1750 gave Bowes a précis of the state of operations at several mines

[244] *D/St/C1/3/58 (2),* Letter from Nathan Horn to George Bowes.
[245] *D/St/C4/1/3*, copy letter to Mr. Cleaver at Castle Howard.

other than the problem at Crinkle How:

"I have made all the pays at our unprofitable Lead Mines, and Mr. Ripon having appointed a day for Crinkle How, I met him accordingly when we cleared off all expences there off the workmen. A Moyety of the whole of Crinkle How charge from the beginning comes to £166.12.3 ¼. From the trials hitherto made, it is impossible to say what may be expected from that Mine,. Nathan says, she is hopeful, Mr. Ripon keeps silent, and will say nothing either for or against her.

The Tacks at Standards, Arngill, and Close House are all out. The Tennants who had them hitherto have not pushed on the Workings so briskly as they ought to have done. Only employing their vacant time they had to spare from their other business. We think to joyn some more hands to them…

Nothing has been done at Green Mine or elsewhere, thro' the severity of the weather, we hope for better, and shall then set all hands at work. I think it is your design to make as many trials and in a many places as there may be any Likelyhood of proving such veins as are hopeful to get ore, and for this end, please let us have Orders about what is now mentioned, and afterwards, as occasion may offer, we shall desire the like approbation….". [246] Unfortunately, there is no documentary evidence of Bowes' response, other than the confirmation by Colpitts in his letter to Cleaver that his master had dealt with the Crinkle How matter face-to-face with Lord Carlisle.[247]

By the 1750's, however, Nathan Horn was in a much stronger position both as mines steward manager and in terms of his influence within the Bowes lead business. Horn imparted positive progress at Rowton Sike, where Bowes eventually offered a partnership to Charles Wensley. On January 6th 1754 he wrote to Bowes in London, that the bottom of the limestone had been reached at Rowton Sike having

[246] *D/St/C/1/5 (4)* extracted from Colpitts' letter of 15th February 1750 to George Bowes, Hanover Square, London. Mr. Ripon was probably Carlisle's mines steward.

[247] *D/St/2/1/5(4)* Thomas Colpitts' letter to Mr. Cleaver at Castle Howard dated 9th March 1750.

driven through thirteen fathoms of it.[248] Then on 24th May 1754 he sent a progress report to Bowes informing him that quality ore had been found at Rowton Sike, that ore had been found at Green Mines ,but not the main vein, where ten men were working.[249] These two pieces of correspondence also describe activities at Standards, Close House, and Isabell-Meah-Hill Mines, and from the first two Horn expected between ten and twelve bing of duty ore in the summer of 1754. In the January 1754 Horn informed Bowes that fifty-six bing of ore had been delivered to a Mr. Appleby at Eggleston smelt mill, who had told Horn that the money for this ore would be ready at Raby Castle, the Vane family residence.[250]

Nathan Horn, clearly well established in his role as mines steward by the end of the 1740s and more influential, continued to be managed, however, because he reported to Thomas Colpitts II, chief steward at Streatlam. In 1755 Horn wrote that the middle vein of lead at Rowton Sike had been cut, that it was ten feet wide, but that the rock was very hard and needed blasting. In addition he had made ten bargains with miners 'to sink' at 30s a bing, yet only five or six stones of lead ore had actually been obtained beforehand. So, Horn's opinion and management of the Bowes lead mines remained salient in the field.

In 1756, when George Bowes was evaluating the state of his lead business and reconsidering his strategy towards the operation and management of the mines and the smelting of metallic lead, because he was pondering its viability, Nathan Horn continued to supply him with optimistic information. In October 1756 Horn reported that Jonathan Watson's progress in mining at Closehouse was expected to last "some years", that Mr. Furnice had sunk a shaft at Sun Vein at Closehouse, and

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[248] *D/St/C1/3/58 (5)* Nathan Horn to George Bowes in London in a letter dated 6th January 1754.
[249] *D/St/C1/3/58 (4)* Nathan Horn's letter to Bowes of 24th May 1754.
[250] *D/St/C1/3/58 (5),* Horn to Bowes 6th January 1754.

that hushing was in operation at Standards and Arngill mines.[251] At this stage Horn's reports appear to have been the only source of management information regarding lead production on the Bowes estate; he held the monopoly of trust and influence. This was to change somewhat after the Wemmergill smelt mill became operational under the management of John Gibson in 1757.

The significance of tacks and leases as management tools will be discussed below , but the memoranda exchanged between George Bowes and his stewards regarding their enactment and the progress of mine workings provides further clarification of how industrious Nathan Horn was and when many of the lead mines were actually in operation. For example, Arngill was working in 1746, was leased out for the two years from 1st September 1748, found itself available for letting in August 1751, was noted by Bowes in projected ore production figures in 1754, and was still being worked in 1756.[252] Closehouse mine was leased for three years in 1747,

was taken on by one Jonathan Watson in 1751, was evidently in continued production during the 1750's, and under Bowes' control in the latter years of this decade.[253] In the

late 1750's George Bowes brought Black Ark mine into operation.[254] Horn and other stewards, regardless of rank, were responsible for imposing the terms of tacks and leases, and for reporting forfeiture which in turn instigated the introduction of new lessees under new tacks for continuity of lead mining. The continuity of lead mining

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[251] *D/St/B2/93(3)* an anonymous report dated 20th October 1756 concerning some of the mines mentioned in Bowes original memorandum of 16th October 1756.

[252] *D/St/B2/81* account of duty ore delivered from Arngill mine; *D/St/B2/21* George Bowes' memorandum dated 20th August 1748; *D/St/B2/21* George Bowes' memorandum dated 16th August 1751; and *D/St/B2/93* memoranda and reports on various mines for the period 1756-61.

[253] *D/St/B2/21* Bowes memorandum of20th August 1748; *D/St/B2/22* Bowes memo; *D/St/C1/3/58 (4&5)* letters between Bowes and his agents 1737-1754; *D/St/B2/93(1,3 & 4)* memoranda and reports on various mines 1756-61; *D/St/ C3/76 (9 & 12)* letters between agents 1751-1765.

[254] *D/St/C3/76(1,6,8, & 11),* letters between agents, and *D/St/B2/93(1)* memoranda and reports 1756-61.

in terms of the number of tacks and leases granted, together with reports of mining progress, can perhaps be taken as a general, if limited, quantification of the mines steward's efforts. Whether or not Horn's management style and application of is skills and knowledge improved output and productivity is difficult to determine.

Nathan Horn was his mines steward during the 1740's and 1750's, and his many reports and letters identify him as a key figure in Bowes' management structure, with considerable knowledge and experience of lead mining, which Bowes valued and drew upon in his plans for the expansion of lead production. Horn was clearly an experienced lead miner who became a mines steward, a specialist manager, who was essential to George Bowes' lead business. He dealt with day-to-day mining operations, whilst Gibson specialised in smelting. Horn's role was to oversee both leased and owned lead mines, which included providing guidance on mine working methods, sometimes act as a merchant buying ore when the opportunity arose, arrange bargains with miners at mines owned by Bowes, and ensuring that leased mines remained in operation, regardless of who the lessee(s) were. The purpose of Horn's work was to maximise the extraction of lead ore and to inform George Bowes of progress at the lead mines by reporting to Richard Stephenson at Gibside, though in some instances he communicated directly with his master. Nathan Horne appears to have been entrusted with this important role throughout the period 1741-60 and was well paid compared to John Gibson, earning twice as much. Both Stephenson and George Bowes respected his opinion, but his efforts were closely scrutinised by Stephenson because Bowes demanded results in the form of lead ore smelted into marketable lead as quickly as possible. Stephenson's instructions, directed by Bowes, were intended to drive Horn's work in the minefields.

Nathan Horn had knowledge and experience in lead mining, and

though focused on his own task, remained blinkered to the broader aspects of the lead production process. His standing within the estate and degree of influence with George Bowes was high during the 1740s and early 1750s; Horn, not Gibson, communicated directly with George Bowes. Horn's management of both miners and lessees was uncompromising and at times ruthless, characterised by some poor decision-making. Furthermore, his management style was typified by unconventional conduct in the field, which miners and lessees probably considered untypical of the Bowes estate's business culture. After the estate lead operations became centralised on Wemmergill in 1757, Horn proved himself unable to work in tandem with Gibson, to whom he was accountable for reports regarding ore output. His management methods, and by implication his honesty, were questioned by senior steward Richard Stephenson in the late 1750s. Horn also appears to have balked at change for improvement, and by 1760 was probably becoming a liability rather than an asset. Nathan Horn was creative in the sense that he managed for almost twenty years to give the impression that he was performing his role, usually in the form of optimistic reports. A range of documents supports this summary of his behaviour, conduct, and mindset.

Horne's influence and position were rooted in happenstance; he was at the birth of the Isabell-mea-Hill lead mine and enjoyed favour accordingly as the vein was exploited during the 1740s. Several examples of his direct correspondence with George Bowes are noted above; progress reports for Isabell-mea-Hill in the 1740s, and developments at Lunehead, and in the 1750s reports regarding discoveries at Rowton Syke and Closehouse. Horn definitely had Bowes' ear, and his standing in the field was apparently unsurpassable. John Gibson addressed all his correspondence and reports to senior stewards, particularly Richard Stephenson; there

are no examples of him communicating directly with George Bowes.

Horn was uncompromising, at times ruthless, in his management of both miners employed by Bowes and adventurers, or those working for adventurers, who held tack and leases on the Bowes estate, which proved poor decision-making. John Gibson's report to Richard Stephenson in October 1758 included an objective questioning of Horn's mining methods and man-management skills, which he clearly believed were causal in wasteful expenditure on lead production.[255] At Birkdale Horn had "ejected the hushers" before they had completed their work of uncovering the ore, and was "carrying up a level at Blackark, which most experienced Miners say, will answer no manner of Purpose". Gibson summarised Horn's, and indicating his own understanding of appropriate management: "He neither promotes our Master's Interest, nor encourages such Persons as have a Lease or Tack of the Mines; for, if he cannot buy their Ore at his own Price, he threatens to turn the Lessees off as soon as their Leases are expir'd. He has told me as much some time ago, with regard to Watson & Collison, and if he should effect his Design, & the Mines either lie neglected, or be Managed to a considerable Loss, it would be a great Disadvantage to our Master".

Evidently, Horn's handling of adventurers and miners was causing production problems even before Gibson's arrival at the Wemmergill smelt mill. In February 1753 one Tim Bainbridge wrote to Stephenson on behalf of himself and his partners, William Tarn and John Bainbridge, asking if George Bowes would meet them to resolve a problem they had with Nathan Horn, who considered that they had not met their bargain at Isabell-Meah-Hill made in 1752 and were unwilling to accept his advice regarding manpower, and refused to either pay them ore collect the ore

[255] *D/St/C/3/77 (7)* Gibson's three-page report to Stephenson 10th October 1758

they had mined. Bainbridge stated that the partners could prove how much ore was produced because it was sold to a Mr. Appleby at Eggleston mill.[256] Stephenson's reply upheld Horn's account of the dispute, giving us an indication of the weight within the management structure of Horn's opinion.[257] The situation worsened within the next few months, and on 1st June 1754 Bainbridge wrote from Birkdale mine complaining in no uncertain terms that he and his partners were having success at Isabell-Meah-Hill, but that Horn was refusing to supply the appropriate equipment, proper living accommodation, or victuals. Consequently, they were forced to raise the price of ore per bing to buy food. Horn was accused of making false promises about payment, and they needed money urgently in order to employ more men to produce more ore. Bainbridge remarked that "If Mr. Horn or any other of Mr. Bowes agents think it not worthwhile to lay out money for the things that is needful we are ready to pay a guinea a bing to Mr. Bowes and quit him from all Expence".[258] In other words, these miners would accept full liability for the mining and pay a royalty to the Bowes. Perhaps George Bowes himself had instructed Horn to take this ruthless approach in dealing with miners, maybe because there was a shortage of working capital in lead mining in the late 1750's and Bowes had tightened the purse strings.

An inability to commit to collaborative work and the compilation of objective management information seem to have been two other weaknesses displayed by Horn. As far as Horn's record keeping was concerned Gibson commented "He gets great Part of his accounts made up from the Work people's Memorandums, hence he has nothing to rely on, but their Word".[259] Early in 1758 Gibson's letter to Stephenson pointed out that Horne had not paid the miners in full,

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256 *D/St/C2/3/75 (4)* Tim Bainbridge's letter to Stephenson 11th February 1753.
257 *D/St/C2/3/75 (3)* Stephenson's letter to Bainbridge 23rd February 1754.
258 *D/St/C2/3/75 (5),* Bainbridge's letter to Stephenson 1st June 1754.
259 *D/St/C/3/77 (7*) Gibson's report to Stephenson 10th October 1758.

enclosed “an account of the Stock Remaining at the Mill December 31. 1757”. This letter also mentions that Stephenson had requested an account of the lead mines from Horn, but to no avail. Gibson informed him that he had shown Nathan Horn Stephenson’s letter to Gibson of 13th February 1758 requesting the information, and that Horn said he would comply the following week.[260] At times Horn showed either carelessness or lack of understanding of the annual process of production and marketing. For example, in June 1758 Gibson wrote asking Stephenson to ”acquaint our Master “ with the fact that Horn had not sent all the ore for smelting, which in turn would slow down the whole process of getting lead to market in good weather, a delay of three months, and would “lay the carriers idle”, and ore would be left at the mill. He respectfully requested from Bowes “an Order of what must be done”.[261] Gibson knew that Bowes’ expectations were not being met, but would not act without a decision from “our Master”, nor would it seem that Stephenson had the authority.

Nathan Horn held a position of entrenched trust during the 1740s and worked to maintain an unchanging mining regime. Horn balked at change in any form. In Gibson’s detailed report of 1758 he suggested that “Some Improvement might be made in Manufacturing the Ore”, but that when he mentioned it to Horn, Horn informed the smelter at the Mill to ignore Gibson.[262] He was resistant to immigrants from other lead mining regions who’s experience and knowledge could have potentially improved mines output without his assistance. In a letter to George Bowes Horn passed an opinion to deter the presence of the “Derbyshire gentelmen” who had participated in trial mines with Bowes. He was referring to George Tissington and his colleagues, a member of the Tissington mining family from Derbyshire, who had an interest in the copper mines at Middle Tyas and who was

[260] *D/St/C2/3/77 (9)* Gibson’s letter to Stephenson 15th February 1758.
[261] *D/St/C2/3/77 (4)* Gibson’s letter to Stephenson 24th June 1758.
[262] *D/St/C/3/77* Gibson’s report to Stephenson 10th October 1758.

granted a lease by George Bowes for lead and copper on Micklefell in 1756. Horn stated that unless Tissington's team were included in the lease with the Earl of Thanet, then Bowes should not expect them to meet their share of the costs for the trial mine. Horn cited a similar incident at Black Sike mine where they had not paid, and Horn's son had confirmed this because he had worked at Black Sike from its very beginning. Horn offered a solution: if Bowes wrote to a "Mr Gors", presumably the Earl of Thanet's agent, or spoke to the Earl himself, Bowes may have been allowed to bring in other partners to share costs by introducing working capital.[263]

Horn was creative in a platitudinous way: his reports were usually very general, lacking detail and objectivity, and always intentionally optimistic – Horn's position was at stake! This style of reporting, already noted above, became more common during the 1750s. Horn wrote to Stephenson in February 1758 and gave an account of activity at Isabell-Meah-Hill, Black Ark, and Rowton Syke mines in terms of costs, lead ore at the mines, and the potential of the mines including Black Sike, his accountability to Stephenson demonstrated in optimistic terms. During August, October, November, and December 1758 Horn wrote to Richard Stephenson reporting deliveries of lead together with estimates of its value, itemising ore purchased from lessees, and mentioning some sales.[264] These letter seem to have given

Stephenson an impression of acceptable productivity at the mines, and ore reaching the Wemmergill smelt mill on time. In April 1759 Horn wrote to Stephenson twice; on the first occasion he provided a vague update of smelting activity, saying that he needed more information from Gibson; on the second he reported good progress at

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[263] *D/St/C2/3/76 (8&9)* Hornes' letter to George Bowes, undated, of December 1758/January 1759.

[264] *D/St/C2/3/76 (18)* Horn's letter to Stephenson of 25th August 1758; *D/St/C2/3/76 (16)* Horn's letter to Stephenson of 28th October 1758; *D/St/C2/3/76 (15),* Horn's letter to Stephenson of 16th November 1758; and *D/St/C2/3/76 (13)* Horn's letter to Stephenson of 10th December 1758.

Isabell-Meah-Hill and Blackark mines.[265] Once again, Horn was supplying Stephenson

with a positive picture of lead mining and smelting, without any details, and in contradiction to Gibson's analytical reports. Horn's occasional role as a buyer and seller of lead ore on his master's behalf also permitted Horn to show off his prowess in the field. Horn requested "to know how lead sells in Newcastle for I have the offer to buy about 20 bing of ore near Brough".[266] It is mentioned above that Horne wrote to directly to George Bowes about the same matter to give the impression he was working efficiently.

Nathan Horn's management eventually came under scrutiny, and his methods and honesty were questioned by Richard Stephenson who appears to have become very frustrated by Horn. On 28th November 1758 Stephenson wrote to Horn in response to his letter of 16th November, instructing him to investigate as to why thirty-four pieces of lead had gone missing when the delivery from the mill reached the staith.[267] In another reply to Horn, after considering the contents of his mine steward's recent letters, Stephenson concluded that 'the Mines are not in a very hopeful way after this great expence'.[268] He advised Horn to transport the lead from the mill to Wolsingham 'now when the Roads are good'. Most notable, however, is that Stephenson's anxiety about George Bowes likely reaction is written clearly in his final paragraph: 'My Master is coming down in a hurry to pressure for a new Tryal, we don't know other than that he will be there this week' –the ultimate threat. In December 1758 or very early in January 1759, Horn wrote to George Bowes in London detailing the particulars of the most recent pay bills at Rowton Syke, Isabell-

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[265] *D/St/C2/3/76 (8 &9)* Horn's letters to Stephenson of 2nd April and 27th April 1759.
[266] *D/St/C2/3/76 (11)* Horn's letter to Stephenson of 20th February 1758.
[267] *D/St/C2/3/76 (14),* Stephenson's letter to Horn of 28th November 1759.
[268] *D/St/C2/3/76 (7),* Richard Stephenson's letter to Horn of 8th May 1759.

Meah-Hill, Closehouse, the Earl's Liberty - Bowes' lease with the Earl of Thanet for Silverkellwell, Arngill, and Standards mines. Horn calculated the total to be £505, 2, 9., but Stephenson found this in error by £100 and noted this on the letter as 'particulars of lead pay where there is a mistake of 100 pounds cashing up'.[269]

John Gibson was appointed as the Wemmergill melt mill manager because of his experience and knowledge of the lead industry, and particularly smelting. Nathan Horn hired him on behalf of George Bowes. Gibson was an educated, intelligent man, loyal, conscientious, dedicated, and responsible. He behaved in an entirely professional manner throughout this career on the Bowes estate. During his four years managing the smelt mill at Wemmergill before George Bowes died he was effectively the controller of all lead operations in Upper Teesdale regardless of Horn's behaviour. He proved that he was creative and potentially very beneficial to the Bowes estate, and capable of delivering positive change in a risky business. The correspondence between Gibson and Stephenson reflects a mutual respect and understanding of the situation Gibson faced in his genuine desire to assist Bowes in his expansion of a profitable lead business. Gibson acted professionally; his reports and accounts evidence his knowledge and general ability, and are of considerably better quality, both in statistical detail and analysis compared to those supplied by Nathan Horn. Unfortunately for Bowes and Gibson, his arrival came too late, because Horn held a deeply entrenched position of influence. In addition to which Horn could behave in a ruthless manner when necessary, which may have been to Bowes' liking, perhaps exemplifying in the field the George Bowes' style of management.

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[269] *D/St/C2/3/76 (12),* Horn's letter to George Bowes, undated, but wishing Bowes and his wife and daughter a happy New Year.

Gibson demonstrated an understanding of the lead production process and the consequences of not managing the various stages in timely fashion. On 1st May 1759 he wrote to Stephenson asking for permission to employ the carriers because they 'have had very little or no Employment for a considerable time …' and '…..if you think proper they might be carrying Lead to Wolsingham'.[270] He added that there was no ore at the Mill, and that the smelter had gone to work as a miner. 'I think we shall have a poor summer's work', he concluded. The contents of John Gibson's earlier correspondence, tantamount to a prediction, had come true. On the 30th May Gibson wrote again to Stephenson, because he had not received a reply to his letter of the 1st May, pointing out that weather conditions, long days, and the state of the roads were conducive to transporting the lead. Gibson begged for an immediate response. He was evidently extremely worried about the slowing down in production. Gibson had accepted the adverse circumstances and decided to remain as Wemmergill Smelt Mill manager, although at the end of September 1759 he wrote to Stephenson confirming that only a relatively small amount of ore was at the Mill, that the smelted lead had been delivered , and consequently he had been reduced to smelting slags.[271]

Gibson's record keeping, reports, and consistently regular correspondence with as senior steward at Gibside confirm that he was dedicated to his role as manager of Bowes' smelt mill, and capable of demonstrating a deep understanding of the different stages of lead production. He was loyal to Bowes and understood his master's objectives, but believed that the mines could have been more profitable if Bowes adopted his suggestions for improving the organization of mining. Gibson's correspondence with Richard Stephenson shows genuine concern for

[270] *D/St/C/3/77 (10),* Gibson to Stephenson 1st May 1759.

[271] *D/St/C/3/77 (12),* Gibson's letter to Stephenson 29th September 1759.

George Bowes' profits and plans for the lead business, yet it also points to the fallibility of the structure and methods that George Bowes and the inherited estate management had imposed on the lead business. Gibson was a specialist and was the calibre of manager Bowes needed. He was evidently highly professional, but at this time lacking in influence compared to Horn where Bowes was concerned, having only recently been appointed. Stephenson knew Bowes well, and could predict his likely ruthless response, knowing that Gibson would be difficult to replace if he decided to leave the Mill. Yet Gibson's professional view of the current state of the lead mines concurred with Stephenson, but his was more incisive as he wrote in his letter of 30th August 1758: 'If all the Mines were let at 1/6 Duty, a great deal more Ore would be rais'd, hence a large Profit would result to our Master'. He preceded this considered remark with an unequivocal statement that he was not expecting much ore at the Mill, unless it was bought in. It would seem his proposal was ignored; there is no evidence to suggest otherwise.

Gibson's desire to serve the Bowes estate, his conscientiousness, astuteness, general good qualities, and creative ability are exhibited in his three page report to Richard Stephenson of October 1758,[272] and because of its content this document, encapsulating the very essence of the Bowes lead business in the mid-eighteenth century, ranks for the purposes of this thesis as probably the most historically significant in the Strathmore collection.. Gibson produced a detailed analysis of how Bowes could cut costs, reduce his exposure to risk, and improve profits by letting the mines at 1/6th duty.[273] This report was sent to Stephenson, but in the sincere hope he would present it to Bowes, warrants some attention, because if

[272] *D/St/C/3/77 (7)* Gibson's three page report to Richard Stephenson at Gibside of 10th October 1758
[273] *D/St/C/3/77 (7)* Gibson's three-page report to Stephenson 10th October 1758.

Bowes had adopted its contents it he would have wrought significant changes in his business strategy for lead.

Gibson's diagnosis of the condition of Bowes' lead interests in the late 1750s focused on two sources of the decline in production remarked upon by Stephenson in his letter to Gibson: the method of organisation; and Nathan Horn's management of the mines in his role as Bowes' long term, trusted mines steward. John Gibson's thoughtful and well-presented report analysed ore production at seven Mines during 1757: Lunehead, Closehouse, Arngill, Standards, Blackark, Green Mines, and Birkdale, and of these only Birkdale was owned and operated by Bowes under the direct management of Horn. His observations demonstrated that at the same levels of production George Bowes would have increased his profit from £127 13s 7 ½ d. to £200 8s ½d. if Birkdale, 'reckon'd the best Mine in the Lordship, Gibson remarked, had been let to some other adventurer(s) at the same 1/6th duty ore as the other six mines. Gibson calculated a loss of £72 -15s at Birkdale, so consequently, and quite reasonably, deduced that Bowes' 'worst Mines would have been attended with a proportionable Loss, if they had been carried on p. Mr. Horne'.

Gibson was forthright and scathing in his assessment of Nathan Horn's management, who he also believed was somewhat dilatory, over-salaried, and the root cause of George Bowes' unnecessary expense at the mines. 'The Mines are in a very poor condition, & 'tis the unanimous opinion of such as are skill'd in Minery, that they will never flourish, so long as Mr. Horne has the Direction. The small quantities of ore he raises are generally attended with a great deal more Expence than the ore is worth. But if all the Mines were let at 1/6th duty, much more Ore would be raised, consequently no Loss, but a large Profit would result to our Master….'. Then concentrating on the loss to Bowes he wrote 'I shall not pretend to calculate the Loss;

only, shall observe that……..Ore at Lunehead, reckon'd the far worse end of the Field, ….the neat Profit arising from. …Duty is £27… If the Paybills for several Years past were inspected, what was lost at the better End of the Field, where Mr. Horne was a Director would appear. Which would still be in favour of letting the Mines'. Almost a year later, when Gibson sought instructions for lead carriage, he took the opportunity to mention his report analysing the mines. 'Our Master, I suppose will be down shortly, if he is not already come, & then I hope you will lay before him the Difference between the Management of his Mines and letting them at 1/6th Duty'. [274] It is not known if George Bowes received this report.

In March 1761, three months after George Bowes died, John Gibson produced a sequel to his original report, written and presented in a similar manner to that of October 1758, but with further detail and focusing on Birkdale 'as it is reckoned the best in the Lordship'.[275] Over the period of his profit and loss analysis, March 1757 to 7th March 1761, he calculated that loss working Birkdale mine over the four years was £467, 3s, 7d. Gibson stated the loss 'In driving Levels etc. at Blackark…' as £340, 7s,0d, which brought the 'Loss at Birkdale Blackark……£807, 10s, 7d'. The report then compares working by letting Birkdale mine at one-sixth duty ore in a worst case scenario, i.e. where costs of working the mine in terms of pay and other expenses were assumed lower than would have been the case, thereby weighting the comparison in favour of working, and calculated that 'The profit in favour of letting is……£9, 0, 0,'. John Gibson's concluding remarks confirm that George Bowes must have either ignored his advice or had never seen the original analysis after Richard Stephenson received it in October 1758: 'Tho' pretty large sums of Money are annually expended at the

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274 *D/St/C/3/77 (11),* Gibson's letter to Stephenson 30th May 1759.
275 *D/St/B2/93 (4)* Gibson's report of 11th March 1761, presumably to Stephenson.

Mines, the Workmen in general complain of their Wages. And as so little ore is Raised; the Mines must either be bad, or, imprudently managed. Hence, it would be more safe and advantageous to let them at Duty'.[276] Nathan Horn is not mentioned anywhere in this report, with Gibson referring to the mismanagement of the mines thus inferring Horn's culpability. Nonetheless, George Bowes' lead mines were in an unhealthy condition during the late 1750', the years preceding his death, with even the potentially better mines operating at a loss.

John Gibson was undoubtedly an asset to the underdeveloped Bowes lead business, but he was seriously undervalued, yet his continued to show indefatigable professionalism and loyalty. Previously he had assayed Birkdale and Lunehead ore 'both for Lead and Silver, drew a Plan of a Smelt Mill, came up to the Mill several times while it was building……..& never had any consideration'.[277] Gibson was unhappy about the poor treatment he received. Subsequently, late in1757 he asked Stephenson to obtain Bowes' permission to rectify the situation. Gibson had written to Stephenson on 22nd September 1757 stating that unless Bowes gave him a salary of £20 per annum he wished to be discharged from service.[278] Gibson raised the issue in his letter of 15th February 1758, and again in his letter of 30th August 1758 when he asked for a salary of £20 per annum. Stephenson replied on the 27th September stating that in his opinion George Bowes would not consider it 'For as long as the Lead Mines are in such a declining state my Master will give out no Salarys but rather lessen them'.[279] He added 'Without

Flattery I think you a very fit person for the Business'. The professional he was

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[276] All quotations in this paragraph are from *D/St/B2/93 (4),* Gibson's report of 11th March 1761.
[277] *D/St/C2/3/77 (5)* Gibson's letter to Stephenson 30th August 1758.
[278] Confirmed in the final paragraph of Gibson's report to Stephenson of 10th October 1758.
[279] *D/St/C2/3/77 (6)* Stephenson's letter to Gibson 27th September 1758.

prevented him from leaving of his own volition, and he continued to provide detailed reports and accounts even after Bowes died in 1760. These documents appear to prove Gibson was correct in his assessment of Bowes' lead interests, and that either Bowes was never made aware of the Gibson report, and therefore continued along the same lines with Horn managing the whole operation in the field, or that he chose to ignore it.

The monopsony – position of being sole buyer – that existed on the Bowes estate during the George Bowes' patriarchy was generally stipulated in the terms of tacks, or short-term licenses, and leases that prevented the adventurers and miners from selling lead ore outside this artificial market. There were times when ore was exogenously sourced and bought in by Bowes agents, an activity operating within the local free market. Enforcing the terms of tacks and leases regulated the Bowes' monopsony, and the development of these legal arrangements as property rights for those engaged in an industrial process during the mid-eighteenth century warrants analysis as an indication of innovation, at least within the Bowes estate management system, which had both contemporary and longer term consequences for the family's estate.

The tacks, or short-term licenses of usually not more than a year for exploratory and prospecting work, and leases for longer-term mining can be categorised according to the characteristics of their structure, and there are a number of variations all largely determined by the Bowes' perception of any particular mine's potential, and the extent to which he intended to be directly involved. The main categories are as follows described by the common items in each case:

1. Duty ore as a fraction of lessee(s) ore production, Bowes to have first call to buy the ore, and ore to be dressed ‘washed and merchantable’ for smelting, and forfeiture criteria, but no money rent.

2. As above and including provision of housing and equipment by Bowes.

3. As in 1 above and including provision for Bowes to share costs of mining.

4. As in 1 above, and including permission to install mining equipment, and possibly smelting facilities.

5. As in 1 above and including Bowes as either a partner from outset or the option to take a share in the venture at will.

There could also have been some degree of variation in the categories outlined above, but the key features of the different forms of tack and lease have been identified here. It must be emphasised that the primary function of tacks and leases was to establish the Bowes position as preferential buyer of washed and dressed lead ore, evidently a non-negotiable condition for lead mining on their estate . In this way Bowes

controlled demand and dictated the price of ore at the mine, the price being a function of the Newcastle and London markets for smelted lead. George Bowes was a monopsonist in the lead production process on his estate, a role crystallised in legal form. In addition, it should be remembered that Bowes operated certain mines alone, as well as some in partnership, and the different partnerships will be examined below. The leases in which Bowes agreed to supply equipment, tools and buildings, assist in clarifying his role as a family capitalist investing in the growth of a rural industry aimed at exploiting the market for a metalliferrous product. George Bowes must be seen as capitalist, because his objective was to control the supply of lead ore and its smelting.

A comparative analysis of the tacks and leases is fundamental to understanding how Bowes refined their use as a management tool, indeed as a means

of enforcement, in both the development of the lessees' approach to lead mining through mining methods and the size of workforce, and the preparative work Bowes believed was required to preserve the value of the factor endowment bestowed upon his family. George Bowes saw greater potential for financial gain from lead production, and directed his agents and managers to exploit its existence throughout his estates in Upper Teesdale. He harnessed the enthusiasm of miners and non-miner adventurers, using them to carry out initial explorations and trial workings or to take on existing workings where leases had been forfeited either because money had run out or miners had vacated because they had not been paid. A forfeited lease could be renewed with the next group of optimistic adventurers willing to finance the risk and pay Bowes duty ore, and agree to other stipulations in a lease drawn up to minimise his risk of loss. The Bowes' lead mines were closely managed, and those not worked by Bowes himself were controlled using tacks and leases. The development of leases over time underpinned the organisational changes in lead mining that Bowes managed into place as a forerunner to increased capitalisation in the later eighteenth century. Leases and tack notes as indicators of the level of mining activity are discussed below, but their nature and characteristics as instruments of controlling lead production as a key component in developing the potential of Bowes estate are worthy of exploration because they are also a guide to his objective of achieving both horizontal and vertical integration in the production process.

There are two views of lead-mine leasing relevant to this study. Burt has argued that leasing by landowners in England and Wales during the eighteenth century was more usual than exploitation of their property, either because they were uninterested or averse to risking the costs of lead mining expansion beyond surface and shallower workings. Moreover, he suggests that 'by the mid-eighteenth century a

general lease of all minerals on a given property to one company was becoming unusual, even to the largest companies'.[280] Leases were granted by the vein, and often for separate sections of richer veins, and they defined long, narrow plots along the vein allowing, subject to the terms of the leases, adequate space for buildings and equipment to be installed. Lead mining leases were usually agreed for a term of twenty-one years; tacks for a year. The purpose of the mining lease was threefold: to obtain duty ore for the mineral lord which converted into income; to develop the owner's estate for future exploitation whilst simultaneously minimising damage or loss; and to ensure the lessees mined effectively. Burt also maintains that 'only in Derbyshire and other districts where leases were regulated by local mining laws was there consistency over time' when it came to working the lead mines.[281]

In the North Pennines, Raistrick remarks that from the seventeenth century the granting of leases for larger areas of unexplored or little explored land became more common, but that this process was slower in Derbyshire because of local regulations. During the eighteenth century, however, Raistrick argues that the use of smaller tracts or meers along the veins, as described above, restricted the growth in scale of lead mining, which caused the movement toward area leases, and cites the London Lead Company as the prime example of this trend because it took many leases from the Greenwich Hospital to achieve control on Alston Moor.[282]

The form and characteristics of earlier leases must be taken as a prerequisite for a comparative analysis that proves the George Bowes regime introduced extensive changes to their nature. The development of leases over time underpinned the organisational changes in lead mining that Bowes managed into

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[280] Burt, *British Lead*, pp. 33-36
[281] *Ibid.*
[282] Raistrick & Jennings, *History*, pp. 187-190.

place as a forerunner to increased capitalisation in the later eighteenth century. Leases and tack notes as indicators of the level of mining activity are discussed below, but their nature and characteristics as instruments of controlling lead production as a key component in developing the potential of Bowes estate are worthy of exploration because they are also a guide to his objective of achieving both horizontal and vertical integration in the production process. In a broader sense a comparative analysis of the leases before and during George Bowes' patriarchy offers further insight into the economic importance of lead, his business attitude, and business planning in this particular extractive industry.

During period 1657 to 1712 the Bowes family began to recognise the potential value of lead to the estate and need to safeguard the family's wealth, but the use of the mining lease as a means of controlling all aspects of lead production was very limited. The granting of only eight leases cannot be perceived as lift-off stage in the expansion of lead production. Tacks and leases were basic with some variations in wording, but lessees had considerable freedom from Bowes management; there was no template for the growth of a structured lead industry. Bowes' estate management was passive, showing indifference to the inherent value of lead. This aspect of the estate management culture remained unchanged until the late 1730s.

Between 1738 and 1760 George Bowes granted leases to lead mining adventurers and miners as well as operating his own mines, all managed by his stewards. These leases were the basis of his interest in developing lead production, and their wording is further evidence of how seriously it was taken compared to the previous two centuries. Various aspects of the business are revealed in these tacks and leases, including Bowes' direct involvement usually in partnership and with financial input, how he controlled the actual mining operations in terms of methods and

management, and specific strategic points in the process of lead production relating to the getting and smelting of ore.

Initially, most concern was given to the level of duty ore paid to Bowes. Consequently, tighter control of the weight and measurement of ore which the lessees extracted were highlighted in the leases granted to prevent deception and theft, and to avoid financial loss. There are two examples of this in leases of 1738, which at outset were in the form of tack notes. In April 1738 Thomas Taden and Jonathan Watson & Co. agreed to pay one-seventh bing of ore as duty to Bowes, the method and measurement of weighing stated clearly.[283] The tack note was also very specific in clarifying the geographic boundaries of lead mining, which focused on the small area around Wemmergill and Arngill. Later that year a tack note was granted with an option for a seven year lease to John Longstaff & Co. 'to work lead ore from the East Graine of Mirgill Beck down the beck to Mase Beck, up Mase Beck to the Birk Sike Foot, up the sike to the top of Mickle Fell and east to the East Graine of Mirgill Beck ….'. Again, measuring the ore obtained was the key point; Bowes was to receive one-sixth of a bing 'at the Bingstead Each Bing containing sixty fore stones the weight of the pokes or sacks excluded'.[284] Bowes accepted that the apparent

potential might not be realised, that the option to extend the term of the initial tack could prove worthless to all concerned, but he was determined to ensure he received at least his share of any short-term gain without risk and limiting mining operations to very specific areas of his estate.

Then, in 1740 John Dent 'made a Discovery to George Bowes Esq. of

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[283] *D/St/B2/12* tack note with option of 21 years granted to Thomas Taden and Jonathan Watson & Co.

[284] *D/St/B2/13* dated 6th November 1738. This was the exploratory and prospecting work in an area of Bowes land predating the discovery of the lead vein which developed into the mine at Isabell-mea-Hill.

Leadmines and Load Oar being and remaining at a certain place called Isobel mae hill in the parish of Romaldkirk in the County of York'.[285] This was a significant discovery, and for the first time George Bowes became directly involved. He granted Dent a seven-year lease and agreed he could have a quarter share of this mine. The lease does not show any involvement of an agent on behalf of George Bowes, which was normal practice for those of lesser importance. Instead Bowes' signature appears above that of John Dent at the foot of the agreement, which includes the following specific terms: before Dent received his quarter share, one sixth of every bing of lead ore 'washed and merchantable oar', was to be deducted as duty ore for Bowes; Dent was to pay one quarter of all the costs and was not permitted to dispose of any part of his share to anyone without giving preference to Bowes; and George Bowes alone would decide where the ore would go for smelting and refining, including Dent's share.

In summary, Dent's lease, although classed as a lead mining lease served a dual purpose. It was a partnership agreement with clearly stated financial obligations combined with the more usual terms of a lead mine lease of this period. Bowes was to pay three-quarters of the costs, but received one-sixth duty ore regardless. In other words, Dent received almost twenty-one per cent, after the deduction of duty ore, but had to pay twenty-five per cent of costs. George Bowes dictated the price Dent could obtain for his share of the lead ore if it was to be sold rather than smelted, and the site of smelting of all ore from "Isabel mae hill" would also be decided by Bowes. Thus, George Bowes controlled ownership, the production process, and ultimately the profit. The best Dent could do was to negotiate an acceptable price for ore from Bowes' mine steward, and operate the mine to fully

[285] *D/St/B/15* lease dated 25th September 1740 between George Bowes and John Dent, a yeoman of Dufton, Westmoreland.

exploit its potential in the hope that ore would appear in volume.

That George Bowes made a timely decision to become directly involved in lead was proved by the history of lead ore output at Isabell-mea- hill mine. Although it may have been that he initially regretted having a partner with whom he must share profit, the burden was short-lived because Dent died in 1742 and Bowes only paid his widow a fixed amount of £20 per annum and he became sole owner. Overall production and productivity is discussed below, but it is suggested that Isabell-mea- hill's potential acted as the spur for George Bowes to consider and plan the development of lead production rather than allow it to continue on a haphazard basis to the possible detriment of the Bowes' estate, and suffer a lost opportunity to further bolster his family's wealth. The discovery of lead at Isabell-mea-Hill signified the demise of more than a century of passive management, and the end of the transition to active management of mineral exploitation on the Bowes estate.

Consequently, in 1741 Bowes granted a twenty-one year lease to William Horn, Edward Rain, Thomas Horn, William Robinson, and Will Robson for one-fifth duty ore, but with particularly strong stipulations.[286] Again, this lease marries

business structure with the conditions of mining, where the lessees' shares encompass fifty per cent of ownership and costs, and George Bowes holds fifty per cent. This lease, in effect a partnership pay-share agreement, housed the terms giving Bowes control over every aspect of the mine's future. George Bowes had 'the Refusal of the Oar to smelt at my Mill at the Market Price'. In addition, the lessees must 'agree to my having a full moiety, or share of the said Lead Myne if I think it proper to demand it' and 'This Grant to be void if the lessees fix their Bounder shaft

[286] *D/St/B2/16* dated 30th April 1741 for a lead mine north of Long Crag near Mickle Fell.

any ways within two miles of the present workings at Isabell May hills'. Any partner who failed to pay his share of costs for six months would lose his share to the other partners, and if the partners ceased operations for two consecutive months for any reason other than extreme weather conditions, the agreement would be void. Lastly, no partner could dispose of his share without George Bowes' permission.

In 1744 a ten-year lease was granted to mine lead at Closehouse vein, adjoining the Arngill vein, in return for one-sixth bing duty ore, and containing a clause giving George Bowes the preference to buy 'the ore that shall be good'. It was not created in the same detail as the leases mentioned above, and was agreed by steward William Horn on behalf of Bowes. Clearly, its potential must not have warranted, at this stage anyway, the parameters already outlined for Isabell-mae-Hill and Long Crag, but it gave Bowes the economic rent of duty ore and the status of preferential purchaser of better quality lead ore.[287]

A lease of 1746 provides an example of another development in the in their use by George Bowes as a business implement to accelerate ore production. This was granted to Charles Wensley to mine lead at Level Head for seven years, from Lunehead west to Silverkellwell, for which George Bowes would receive one-fifth of the ore.[288] Exact measurements as to where work could be done were quite common, but deadlines regarding progress where not, whereby failure to meet the agreed deadlines would lead to the lessee forfeiting half of the area worked, and the remainder could also be lost if work did not continue with a certain number of men constantly employed. Of course the lessee could only remove the ore for smelting after deducting that due to Bowes, and after any other costs had been met – no risk

[287] *D/St/B2/18* Bowes to Robert Dent and John Bedell dated 8th September 1744.
[288] *DSt/B2/19* dated 13th August 1746 between George Bowes and Charles Wensley.

to Bowes whatsoever. Here are extracts from the lease which highlight the details of management and accountability:

'…Two hundred yards on ye South side of the present Vein, and Two Hundred yards on the northside of the Vein, with leave for water courses and to erect Hovells or Hutts….for the use of the work carry'd on……and to carry off such quantities of Ore as he shall get & to dispose of the same as he shall think fit leaving one Fifth part Of the ore…..clean washed & merchantable as Duty to…G.B. Esq. clear of all charges thereto…….Wensley shall not remove ….any ore without giving notice to the said Geo.Bowes Esq…….and the said Charles Wensley further convenants & agrees to drive 20 fathoms to the Sun from the above Levelhead on or before Martinmas 1747, & 20 Fathoms further to the Sun on or before Martinmas 1748, and on Failure of Driving either of the said 20 Fathoms within ye Times abovementioned then this agreement to cease……And it is further covenanted & agreed that if in the third year of this agreemt the said Charles Wensley do not drive 20 Fathoms now to the Sun in the sd Levell the 200 yards granted above on the southside of the vein to Be forfeited……..but the liberty to work the old vein with 200 yards to the North of it shall be continued for the whole term of seven years, so as that he keep constantly at work at least four men….

Charles Wensley covenants to leave the Shaft and Levell in good repair at ye expiration of the Term, & George Bowes Esq. to have the liberty to drive drifts or water courses through any part of the premises above granted'.[289]

Clearly the terms of this first lease with Charles Wensley at Lunehead are comparatively strict, and suggest that Bowes was keen to make better progress in this area within a specific timescale. Consequently, the lessee was granted a broader

[289] Extracted from *D/St/B2/19.*

range of terms, including liberty to install equipment, create watercourses for ore preparation, construct buildings for storage, and housing for miners, but the method of operation was dictated by specific conditions including distances for sinking and driving, target dates for mining progress, and forfeitures related to under performance during the period of lease. George Bowes strove to develop the system of mining at Lunehead and offered a lease to promote this aim. In this instance he appears to have neither guaranteed preferential purchaser status, nor direction as to smelting, whereas control of mining, and therefore the workforce, were paramount.

The relationship with Wensley developed from 1751 into a partnership at another mine in the Lunehead area, Rowton Syke, where in 1752 George Bowes granted Wensley a twenty-one year lease at a rent of one-sixth of the lead recovered.[290]

The wording of the lease concentrates on the development of the mine's potential and refers not only to George Bowes, but to his heirs, executors and administrators, such was the potential value of this mine to the Bowes estate.

Wensley was permitted to build lodgings for the miners, erect 'gins and engines' and 'smelting houses and drills' for 'the manufacturing of the said Lead Oar and Mineralls'. He was also granted 'wayleave and passage' to and from the mines and mills. There were several other very specific stipulations: at least six men had to be employed at any time; work must not cease for more than twenty days, an then only because of heavy snow or lack of water; all losses, damages, and accidents were Wensley's liability; accounts must be kept and precise measurements used in weighing the ore in 'bings, sacks, pokes'; every aspect of the mine was open to inspection by George Bowes, his agent, a steward, or an overman; all ore was to be 'washed and dressed' and must not be removed without Bowes having the choice of

[290] *D/St/B2/24* dated 1st September 1752, a lease between Bowes and Wensley.

ore as preferential buyer, effectively preventing Wensley from selling to anyone else; and shafts were to be open and well timbered. The duty ore was one-sixth of ore mined, and although there is no mention of Bowes having direction over where the ore would be smelted, Wensley was given the liberty to build smelting houses contrary to earlier leases, and if Bowes avoided the responsibility of smelting he could avoid carriage costs. Hence the wayleave granted to Wensley in this lease. There is no evidence that Wensley did smelt lead near the mine, but Bollihope was out of commission and Bowes did not commence building a smelt mill near the mines until 1756.

The potential for lead mining at Rowton Syke mine was undoubtedly considered relatively good , consequently the lease aimed at maximising gain for Bowes whilst simultaneously protecting the future of the mine for his estate and its heirs. Wensley was prohibited from selling any part of his one-fifth share without George Bowes having first option to buy. Consequently, Bowes controlled the future of the mine and the purchase of the ore during the term of the lease..

The lease granted for lead mining at Rowton Syke was echoed in that between George Bowes and a partnership of adventurers in 1755 for Green Mines, and Quorgill and Langstaff hushes.[291] The additional point included was the permission to take peat for fuel used for heating and in the smelting process. At this stage in his experience with lead, George Bowes leaves us with the impression that he had undergone a learning process; compared to the late 1730s leases were more sophisticated. It is not clear, however, whether this learning curve brought Bowes to the conclusion that there was potentially huge profit in the lead business, or that he

[291] *D/St/B2/29* dated 30th October 1755 between George Bowes and William Dockray, Joseph Cradock,
William Watson, John Cradock, and Anthony Cradock.

simply sought closer control of lessees and he was becoming disinterested. This would signal a return to passive management of lead production.

Tack notes with options for longer-term leases were considered equally important in terms of potential lead ore output and the development of the Bowes' estate. One such license agreed with a Mr. Cradock in the mid-eighteenth century for Green Mines, Toddy Gill and Langstaff Hush, specified the areas of land involved, and stated that if at least four men did not work during the year, then the lease was forfeited.[292] Another tack note in 1755, with an option for 20 or 21 years, between Bowes and Thomas Pierse of Pierseburgh, for an area of land on Mickle Fell, and another, which became known as Nichol Hopple Yard, contained specific measurements, which were to be marked out by Nathan Horn, George Bowes' mines steward, as were 'Founder shafts'.[293] The tack note would have become void if the option to extend was not taken up during the first year, or if work ceased for one month, or if four men were not constantly employed. Again, Bowes had the preference to buy the lead ore at 'the County price', the ore was to be washed and dressed ready for smelting, and the duty ore was one-sixth. The fact that the license was personally drafted by George Bowes is an indication of how seriously he viewed the lead business, and the significance placed upon the use of tack notes leading to longer term mining operations.

Leases and tack notes made during the late1750's were drafted in very brief form. A further agreement was made with Charles Wensley in 1757 for the sole purpose of Bowes or his agents buying Wensley's ore from Lunehead "at a price determined by them".[294] Another tack was granted in 1756, with an option for a

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[292] *D/St/B2/25*, thought to be granted in the mid-eighteenth century.
[293] *D/St/B2/28 (2),* and George Bowes' draft D/St/B2/28 (3).
[294] *D/St/B2/32*

further twenty years, to Samuel Bacon and James Collinson for Standards mine.[295] A nine-year lease was created in 1757 between Bowes and John Robson, Peter Allinson and partners, with wording similar to that of the lease with Thomas Pierse for Nichol Hopple Yard.[296]

In August 1756 a memorandum of an agreement for mining lead and copper at Blacksike, "Nickle hopping yard", White Pitts, and Silverkellwell, which Bowes had leased from the Earl of Thanet, was signed by George Tissington, a member of the Derbyshire mining family, and Nathan Horn on behalf of Bowes.[297] There followed a lease for twenty-one years in September 1756, which referred to areas of Mickle Fell, and the mine workings at "Nickle Hopple Yard" .[298] Essentially, the wording is very similar to the lease with Pierse, requiring one-sixth of the lead and copper ore as duty, and giving Bowes preference to purchase the ore at the County price. It was clearly stipulated that Tissington and his partners were forbidden to build a smelt mill, because Bowes was in the throes of building a new mill at Wemmergill. It would appear, too, that Bowes agreed to the assignment of his lease on Silverkellwell, the only lead mining lease in the Strathmore Papers where he was lessee and not owner, but which at this stage had proved unproductive.

The agreements for mining at Silverkellwell mine tell the story of George Bowes as lead mining adventurer attempting to extract ore under a lease granted by another landowning mineral lord , initially reacting in a dissatisfied manner to the proposed terms, and wishing to avoid taking a dose of his own medicine. Bowes's solicitor advised him to question various points relating to the number of miners and how often they would be paid, as well as querying the

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[295] *D/St/B2/32*
[296] *D/St/B2/32*
[297] *D/St/B2/30* dated 31st August 1756 and written by Tissington.
[298] *D/St/B2/31* dated 6th September 1756 between Bowes and George Tissington and partners.

measurements of the working area on the Earl of Thanet's Westmoreland estate.[299] Typically, Bowes connived to obtain the best terms he could negotiate. Eventually, he accepted a twenty-one year lease whereby one-seventh of the ore would go to the Earl of Thanet, with a £5 penalty for every bing of ore Bowes removed before the ore was divided up accordingly between him and Thanet. The lease was very specific as to how Bowes must operate the mine, including the production of quarterly accounts.[300]

The developing form of the Bowes estate tacks and leases during the mid-eighteenth century presents an alternative pattern of mining organisation to those discovered by both Burt and Raistrick & Jennings described earlier in this chapter. The Bowes estate did not grant a lease to any particular lead mining company, and there was not a tendency to let large areas of land.

The size of working tracts, the physical basis of mining organisation, stated in tacks and leases granted by George Bowes varied greatly. At Isabell-mea-Hill in 1740 it was 800 yard by 200 yards from the first shaft.[301] In 1746 at Level Head, Lunehead, it was an area for searching and digging for lead with breadth measurements of 200 yards either side of the existing vein.[302] The length at Rowton Sike in 1751 was 600 yards east to west either side of the existing shaft, or 200 yards in breadth.[303] The tract granted at Green Mines in 1755 was 1000 by 400 yards,[304] and at Nichol Hopple Yard 800 by 200 yards.[305] In 1756 Bowes granted 1000

by 400 yards at Nichol Hopple Yard, Black Sike, and White Pitts, and 2000 by 800

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[299] *D/St/B2/71(2)* is Mr. Dixon's remarks to Bowes regarding the proposed lease with the Earl of Thanet.

[300] *D/St/B2/71 (1)* dated 18th June 1755 between Sackville, Earl of Thanet and George Bowes for the lead mines at Stainmoor in Westmoreland. In fact it ran from 28th July 1754. The original tack note began 28th July 1753 and the duty was one-seventh of the ore mined (or every eighth pig or piece of lead smelted),see D/St/B2/70.

[301] *D/St/B2/15* Bowes to Dent lease.

[302] *D/St/B2/19* Bowes to Wensley lease.

[303] *D/St/B2/21* memorandum and D/St/B2/24 Bowes to Wensley lease.

[304] *D/St/B2/29* Bowes to various lessees.

[305] *D/St/B2/28* Bowes to Pierseburgh lease.

yards at Silverkellwell.[306] These tracts or meers were in complete contrast to the standard measurement on Alston Moor of 1200 by 80 yards in the eighteenth century.[307] In Swaledale it was usually 30 yards by up to 200 yards, and in Derbyshire 28-32 yards by 14 yards wide.[308] Although there is a feint similarity to measurements used on Alston Moor, those employed by the Bowes estate were granted according to local conditions; the nature of mineralisation, the landscape, proximity of existing workings, and perhaps the financial capabilities of the lessees. The absence of uniformity in this facet of tacks and leases points to small scale mining, an indifference, or more likely an objection to, leasing larger areas of his lead bearing land for a royalty to either a bigger regional or national concern, and to George Bowes' ideas of discovering the longer term potential of the family estate.

A royalty or duty ore was an essential commercial element in any mining lease. The most common royalty or duty ore in Bowes tacks and leases was one-sixth of the ore produced and dressed ready for sale or smelting. This level of duty ore became standard from the early 1740s, and there are only a very few examples of one-seventh, one-eighth, and one-fifth, and no evidence of money rent or fixed sum royalties. In the late 1750s the Bowes John Gibson, the smelt mill manager, expressed a view on the use of duty ore as an incentive to increasing output of ore, and this is examined below. Again, this appears to be in contrast to other mining areas. In discussing this key element of mining leases, Raistrick notes that during the eighteenth century it was between one-fifth and one twenty-fourth in Derbyshire, one-fifth at Grassington Moor, one-ninth in Swaledale, between a fifth and a seventh on Alston Moor before 1764, one-fifth in Weardale, and one fifth north of the River

306 *D/St/B2/30* Bowes to Tissington lease.
307 Raistrick & Jennings, *History*, p.188
308 Burt, *British Lead*, p.36.

Tees.[309] In the North Pennine districts duty ore appears to have been comparatively steady between one-sixth and one-eighth, when in other areas there was a downward trend as mining became deeper requiring more capital input.[310] The level of duty ore for lead mining on the Bowes estate does not appear to have changed regardless of market conditions in the period 1740-60. George Bowes' leases and tacks reflect his stance on the opportunity of increasing his income from mineral wealth in the form of lead on the estate in Upper Teesdale. It is also probable, as Burt has noted, that at this stage in the development of lead extraction in the mid-eighteenth century, much of the ore Bowes was more readily accessible because it was shallower. Consequently, lessees and miners agreed to one-sixth because they were not under the financial pressures brought by deeper mining from the late eighteenth century.[311] Any change in the terms of leases for duty ore would most probably have come in response to costs, otherwise the mineral lord could find himself with dormant lead mines where any previous capital investment was depreciating and the estate income falling, and with less potential for further development and exploration.

The management of mining activity on the Bowes estate during the

mid-eighteenth century was problematic in that it could be intermittent, usually small-scale, and adventurers and miners tended to have a short-term view of lead mining if for no other reason than lack of capital for deeper mining. Consequently, the Bowes stewards dealt with a high degree of uncertainty in managing those taking risks in lead

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[309] Raistrick &Jennings, *History*, p.190 He actually states Teesdale, but the London Lead Company was only working north of the Tees at this stage; it did not have mines on Bowes land south of the River.

[310] A. Raistrick, *Lead mining in the Mid-Pennines* (Truro 1973), p.35. Also see Burt, *British Lead*, pp .38-43.

[311] *Ibid.*

mining. The logistics of developing lead production was akin to herding squirrels; both lessees and miners employed by Bowes had to be inveigled into working according to the terms of bargains, tacks, and leases. At the beginning of the 1740s the form of management was relatively slack, primarily because the nascent lead mining and smelting on Bowes land did not demand such attention. The strategy for growth introduced by George Bowes had three basic features; it was businesslike, regulated, and longer term than at anytime before. The Bowes lead business was small-scale and regional compared to that of the London Lead Company, which had a national presence but based in the North Pennines. During the eighteenth century the London Lead Company employed a hierarchy of agents under a general agent, and they were trained specialists in mining, washing and preparation of ore, and smelting. They had defined authority in their roles and were responsible for enforcing a culture of longer term planning contrary to the small-scale short term thinking of most miners and adventurers of the time.[312] The Blackett-Beaumont enterprise, a regional business, had a chief agent in Newcastle with clerical subordinates for the general management of mining, smelting, transport, and lead sales. This family business consisted of three areas, East and West Allendale, and Weardale, with mining, smelting, and refining each overseen by individual agents. At each mine there were a number of assistant agents, for inspecting the mines, ore preparation, and record keeping.[313]

The numbers of mines and size of workforce on the Bowes estate did not warrant numerous managers and agents, but George Bowes realised the need for a team of specialist stewards for the purpose of bringing his plan for lead to fruition. The system of management he installed during the process of reorganisation was fundamental to later stages of development in the lead industry in Upper

[312] Pollard, *Genesis,* p.18. See also A. Raistrick, *The London (Quaker) Lead Company, 1692-1905* (1938), and *Quakers in Science and Industry* (1950).
[313] Hunt, *Lead Miners,* p.114.

Teesdale. What can be concluded from this discussion of management, mindset, and monopsony?

George Bowes inherited an estate management structure that appears devoid of endogenous specialist stewards for lead production. Nathan Horn and John Gibson were introduced into specific roles as the need arose, but there is no evidence of them being trained for their tasks within the Bowes system. The lead business on the Bowes estate did not warrant more sophisticated practice, but within the estate the arrival of mining and smelting managers was innovative.

Horne's experience was essential in the 1740s, but he was limited in his approach to management because he was a dyed-in-the wool miner lacking broader vision of the lead production process and resistant to change. His attitude towards management was based on self-preservation, ruthlessness, uncompromising behaviour, arrogance, and fear of any change that would result in him losing control of the mining area. By 1760 he had become a liability to the expansion of lead output on the Bowes estate, and it may have been that his honesty was in question. In complete contrast, Gibson was an asset and clearly had the capacity to manage change. He was self-less, professional, and devoted to the Bowes family and their strategy for lead on the estate.

The stewards managing lead production were involved in recruiting miners and adventurers, but the short-term outlook of these small-scale risk takers did not change before 1760. There was a good chance that, had Gibson's strategy been adopted, a cultural change in lead mining would have begun in the late 1750s. George Bowes himself and the senior stewards failed to recognise the value of Gibson's analysis of the lead business, and instead persisted with Horne's approach for two decades. Their failure to initiate a change in organisation and

management had adverse consequences for profit and estate development. This contradicts Oldroyd's argument that the Bowes estate was productive and efficient as a result of the management structure using accounts, certainly as far a the lead aspect of the estate is concerned. Information was shared and accounts were kept, which gave a professional edge to management, but the Bowes lead business was not consistently productive or efficient. George Bowes and his senior stewards failure to act decisively and reorganise with a different management approach meant that lead production was in a state of inertia, and was to remain so for many years.

Tacks and leases granted by George Bowes gave him preferential buyer status - monopsony; in effect he was the sole purchaser of lead ore, and contributed as little a possible by way of incentive towards lead production from either lessees or miners at his own mines. George Bowes, with the assistance of his stewards and solicitors, developed the use of the mining lease during the mid-eighteenth century, raising it from a basic form of agreement whereby the lessee(s) had considerable liberty to find lead ore upon which he generally had first option, to a much stricter form that incorporated specific instructions about the actual mining operation. The common factor of duty ore aside, Bowes controlled lead ore extraction by employing the lease as a management tool which his mines steward and other field agents could wield in their work to organise systematic lead mining. In this way he managed to monopolise the demand for ore and supply his smelt mills with the raw material needed for the manufacturing of metallic lead, pig lead for market. Furthermore, by creating an organised industry lead mining industry on his estate, Bowes began the process of eradicating its longstanding casual and haphazard nature, which was conducive to both the conservation and future development of the estate. Ultimately however, it seems that the market conditions for lead were the invisible

influence on how and when different forms of tack note or lease would be employed, perhaps most easily observed in the late 1750s when tack notes with options to extend the term became more prominent in an effort to continue exploration and trial mines in places already identified as potential sources of lead ore and which could become more viable at a later date. The letting strategy adopted during the1750s suggests that management of the lead mines became progressively more passive, but that the process of cultivating lead production was kept alive by granting tacks and leases even when demand waned.

Lastly, it is evident that the Bowes estate did behave as a firm; its behaviour was determined by George Bowes as entrepreneur, who organised the stewards for the purpose of exploiting lead, planned strategically, introduced working capital, and generally directed the use of resources on the estate. Although the market price of lead in Newcastle was largely beyond his control, he seems to have employed it as the gauge for setting the price of ore mined on his estate, wages, carriage costs and the price of bought in ore. 'A firm, therefore, consists of the system of relationships which comes into existence when the direction of resources is dependent on an entrepreneur'.[314] The role of George Bowes is examined in greater detail below in Chapter 8.

[314] R.H. Coase, 'The Nature of the Firm', *Economica,* new series, vol.4, no.16 (Nov.1937) p.393

Chapter 5: The Mineral, the Mines, and the Men

Historians of the extractive industries have long held the view that lead production in the Teesdale area of the Northern Pennines was relatively insignificant, if not almost non-existent, until the arrival of the London Lead Company during the latter part of the eighteenth century when large-scale mining and smelting began in earnest.[315] Indeed, there are documents in the Strathmore Papers that confirm the London Lead Company leased mines south of the River Tees in 1771.[316] One historian has remarked

that in the eighteenth century 'Teesdale was worked by numerous small groups about whom little information has survived'.[317] Another, referring to the activities of the London Lead Company, states 'the Teesdale mines with their centre at Middleton, experienced an industrial revolution'.[318]

Both academic and local historians have focused their attention on the more Northern Pennine valleys of the rivers Wear, Derwent, and Allen, where lead mining and its related activities are said to have prospered. Consequently, there have been several studies which demonstrate their economic importance during the eighteenth century when Britain was probably the biggest lead producing country in Europe, and the northern Pennine dales were the main area of lead mining[319]. In Weardale, for example, ventures were both more extensive and financially rewarding meeting the demands of the Newcastle market and trade in lead from the River Tyne. It was in Allendale, where the mining rights were owned, and Weardale, where lead

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[315] Raistrick & Jennings, *Lead Mining,* p.152 remark that the London (Quaker) Lead Company only became properly established in Teesdale after 1771.

[316] The London Lead Company's arrival is discussed in a later chapter.

[317] Hunt, *Lead Miners,* p.6.

[4] L. Turnbull, *The History of Lead Mining in North East England* (2nd edition Alnwick 1985), p.11.

[319] Raistrick & Jennings, *History*; Hunt, *Lead Miners*; Turnbull, *Lead Mining*; M. Hughes, *Lead, land and coal*; R.T. Clough, *Lead Smelting Mills of the Yorkshire Dales and the Northern Pennines* (2nd edition Keighley 1980); and B. Chambers (ed), *Men, Mines, and Minerals of the North Pennines* (Friends of Killhope, 1992).

mines were leased from the Bishop of Durham, that the Blackett -Beaumont family developed one of the largest lead-mining concerns of this period. [320] Raistrick & Jennings remark upon the 'steady development' of the Weardale mines during the eighteenth century in terms of deeper shafts and technology, whereas lead mining in Teesdale was 'slow to develop' with 'little record of much work being done'.[321] In the 1850's the Blackett-Beaumonts and the London Lead Company together still represented almost seventy per cent of total lead-mining output in the North Pennine orefield.[322]

The significance of lead production in the northeast economy is underlined by the amount of lead and manufactured lead shipped out of Newcastle and Stockton-on-Tees during the eighteenth century, which rather interestingly reveals Stockton as more important for lead only, with Newcastle more important for manufactured lead, during the period from 1705 until the late 1760's.[323] Lead exports from Stockton in 1755/6 were double those in 1725/6, but fell by almost a quarter between 1755/6 and 1770. Newcastle's trade in lead was approximately four-fifths of Stockton's in 1705, but grew by almost the same rate until 1755/6, but then grew exponentially between the mid-1750s and 1770. [324] There is currently no quantification

of contributions to this trade from different producers in the region.

In summary, if the lead mines and mills of Teesdale contributed to lead production in the North Pennine orefield, very little is known about it in the period before the late eighteenth century. There are few sources of

[320] The Blackett- Beaumont enterprise is the focus of Hughes thesis 'Lead, Land and Coal'
[321] Raistrick & Jennings, *History*, p.152, where once again the London Lead Company is highlighted as the only business in Teesdale of any significance, and then only from 1771.
[322] R. Burt, *British Lead*, p.61. An extensive work paying particular attention to the late eighteenth and nineteenth centuries
[323] R. Burt, 'Lead production in England and Wales 1700-1770', *EcHR* XXII, 2 (1969), appendix I p.267.
[324] *Ibid*. p.257

statistical evidence that shed some light on the level of activity in lead production during the eighteenth century in Teesdale. K.C. Dunham's study of lead production in the North Pennines concentrates on the records of the London Lead Company and the Blackett-Beaummont enterprise, but does not identify output from Teesdale during the sixteenth and seventeenth centuries.[325] The amounts of lead noted above that were traded through the two main ports of Newcastle and Stockton, particularly the latter, suggest that pig lead smelted from ore extracted in Teesdale was a constituent part. The London Lead Company output in Teesdale before 1771 was derived from mines and mills north of the River Tees, whereas the Bowes' lead was extracted from their Upper Teesdale estate south of the River Tees, when this river was the boundary between County Durham and the North Riding of Yorkshire. Any reference to a regional industrial revolution, aforementioned, in terms of generating economic growth and its attendant characteristics, could apply to London Lead Company activities on Alston Moor and Upper Teesdale north of the Tees, but there is no evidence as yet that such a phenomenon occurred on Bowes lands south of the Tees. There are scant references to the possibility of lead production on the Bowes estate during the period of George Bowes' patriarchy, mainly in narratives of industrial archaeology, but even these do not demonstrate a direct connection with the Bowes estate, nor do they provide details of ownership, organisation, investment or trade leading to the development of a structured and profitable lead business.[326]

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[325] K.C. Dunham, 'The Production of Galena and Associated Minerals in the Northern Pennines; with Comparative Statistics for Great Britain' in *Transactions of the Institution of Mining and Metallurgy,* LIII, 1943-44 pp. 181-252.

[326] A. E. Shayler, J. K. Almond, & H.L Beadle, 'Lead Mining and Smelting in Swaledale and Teesdale'
Cleveland Industrial Archaeologist No. 2 (1979) note that note that "Other lead smelting mills at one time stood at Newbiggin, Langdon Beck , and Wemmergill, but information concerning these is scant". H.L. Beadle is an acknowledged contributor to the history of lead mining and other extractive industries in Teesdale including 'Mining and smelting in Teesdale' in *Cleveland Industrial Archaeology Society* (1980), and 'The Smelting Mills of Teesdale and District' in the *Bulletin of Durham County Local History* no. 11, (Nov. 1969), pp. 2-10. Most of his work explores

Teesdale lead in the eighteenth century must account for some of the lead production leaving northeastern ports, probably mainly out of Stockton, as a raw material for manufacture elsewhere in Britain or Europe, but that it does not appear to bring about lead manufacturing in Stockton. Newcastle, on the other hand, was a manufacturing centre as well as port trading in lead, but at first sight does not appear as the natural geographical outlet for Teesdale lead. The contribution of Bowes estate lead mines and smelt mills to the level of production and trade both regionally and nationally have been unknown quantities.

In 1722, after more than a century of relative inertia in lead production and its trade, the Bowes estate came into the possession of George Bowes following the deaths of his two elder brothers William, in 1721, and Thomas, in 1722. His patriarchy proved to be the only instance of a Bowes male beneficiary who, in complete contrast to his descendants, conscientiously exploited the potential of the family estate until his death in 1760. Coal was evidently the most abundant and profitable mineral on the Bowes estates before, during, and after George Bowes' lifetime. Consequently, coal affairs placed a huge demand upon his business and political activities, both in London and the northeast. National and local histories reflect his status as a coal magnate and member of the Grand Alliance which dominated the north east coal industry and the coastal trade to London during the eighteenth century, although even these have not revealed the full extent of his role.[327] Despite the scale of his coal interests, from the late 1720s George Bowes became involved in the exploitation of the other high value mineral found under the family

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very late eighteenth and nineteenth century mining.

[327] See Hughes, *North Country Life*, and M. W. Kirby and M. B. Rose, *Business Enterprise in Modern Britain* (London 1994), ch.5; M.W. Flinn, *The History of the British Coal Industry, Vol. II 1750-1830: The Industrial Revolution* (Oxford 1984), made only limited use of the Strathmore collection.

lands – lead.

This examination of the growth in lead mining on the Bowes' estate in Upper Teesdale aims to address a number of questions. How were the lead veins discovered, and can a level of geological knowledge be established? Where were the lead mines located? How and to what extent were the mines developed? What was the nature of mining technology, and did the Bowes introduce any new methods? How was lead mining financed and organised the under the Bowes regime, and what was the range of Bowes' direct involvement in the extraction of lead? Can Bowes lead production be quantified for this period? What was size of the mining labour force and was mining a seasonal activity? Is it possible to estimate labour productivity? Before proceeding with the analysis of records for the year 1729 to 1760 in an attempt to answer the aforementioned questions, a brief outline of the lead industry's national and regional setting into which George Bowes ventured is essential to the discussion that follows.

There is a long established view that the quickening development of the lead industry began in the late seventeenth century and continued throughout the eighteenth century. Burt has argued that the most rapid expansion was in the 1690s and early 1700s, a consequence of the termination of the Mines Royal monopoly, the diffusion of improved mining technology, the lack of alternative sources for capital investment, the growth in house building, and the growth in overseas trade.[328] He estimated lead production at 28,000 tons in 1705/6, and growing to 59,000 tons in 1769/70.[329] Blanchard's work reinforces Burt's view, but introduces the removal

[328] Burt, *British Lead*, pp. 3-5.
[329] Burt, 'Lead Production', p. 265.

of restrictive practices in lead mining as causal to a 'new expansionary phase' after 1670.[330] Blanchard asserts that the production boom was extinguished by 1760, a consequence of 'resource depletion problems' and the failure of technology to alleviate these problems. The 1750s 'witnessed the end of an era' in lead production, and although seventy-five per cent of production was exported during this decade, it was the beginning of 'the final production cycle of the English industry'.[331] In terms of production by volume "lead was second only to iron …….among the metals" and "by the late eighteenth century Britain was probably the leading lead producer in the world".[332] There was a demand for lead; lucrative markets to be exploited within the North East[333], in London[334], and abroad for those willing to grasp the opportunity in a high-risk business.[335] The domestic market, with London at its core, was the primary target for lead producers, for both pig lead and manufactured lead, with exports not expanding significantly.[336]

George Bowes did recognise the opportunity for profit in the lead market and set about the development of mining and smelting on his estate in Teesdale. The scale of this enterprise compared to that of his seventeenth century predecessors can be assessed by the number of mines and trials, its productivity and profitability, its structure and financial requirements, and the numbers employed in it. Moreover, the significance of this commodity – grey gold – to George Bowes as

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330 Blanchard, *Age,* p.48.
331 *Ibid*. p. 49.
332 D. J. Rowe, *Lead Manufacturing in Britain; a History* (London 1983), p. 12.
333 Burt, 'Lead Production', discusses Newcastle's lead manufacturing as a market for pig lead, p.258.
334 Rowe, *Lead Manufacturing,* pp. 12-13 cites the importance of the growing London market for pig lead from the Pennines via Stockton, Newcastle, and Hull during the eighteenth century.
335 *Ibid* p.12, remarks that during the seventeenth and early eighteenth centuries British lead output exceeded domestic demand and manufacturing capacity, consequently there was an important export trade, especially to Holland.
336 E.B. Schumpeter (ed.), *English Overseas Trade Statistics 1697-1808* (Oxford 1960), table VII.

entrepreneur can be measured by the level of his personal involvement in directing the expansion of lead production whether he was in residence at Streatlam or Gibside, or in London. The lead business, by its very nature, was even riskier than coal, yet from no the later than the 1730s Bowes ventured to organise this particular aspect of his estate's economic activity into an industry in a pre-industrial era. Georges Bowes directed his agents and stewards to exploit the existence of lead throughout his estate in Upper Teesdale. He harnessed the enthusiasm of miners and adventurers, using them to carry out initial trial workings or to take on existing workings where leases had been forfeited either because money had run out or miners had vacated because they had not been paid. Forfeited leases could be renewed with the next optimistic adventurers willing to finance the risk and pay Bowes the royalty of duty ore, and agree to other stipulations in a lease drawn up to minimise his risk of loss either financial or damage to the Bowes estate. In stark contrast with lead mining activity during the preceding century, the period of George Bowes era witnessed an unprecedented change in approach towards the exploitation of lead on the Bowes estate. This in turn meant economic and social changes, which lasted until the at least the mid-nineteenth century, in a barren landscape that would otherwise only have offered a meagre living from agriculture.

The tacks and leases granted by George Bowes, and all but one of his own or partnership mines, were on the moors and fells of his estate in Upper Teesdale in the North Riding of Yorkshire – Mickle Fell, Cronkley Fell, Holwick Fell, Lune Moor and Lune Forest, Hunderthwaite Moor, Mickleton Moor, and Cotherstone Moor. The records refer to manors, because the Bowes estate in this region, on the North Riding side of the River Tees, was organised administratively into manors named after villages adjacent to the river, one exception being the manor of Lune, an

expanse of highland fell wedged between the manors of Holwick, to the north, and Mickleton to the southwest (see map opposite *Lead Mining Landscapes* [Durham County Council 2003]).

The various mines, both pre-existing and new, can be identified within these moors and fells. Green Mines, Isabell-mea –Hill, later known as Birkdale, and Longstaffs Hush are on Mickle Fell. Black Ark, Nichol Hopple Yard, and Cronkley are on Cronkley Fell. Both these fells can be described as desolate and isolated areas. Greenfell and Crinkle(d) How are on Holwick Fell. Black Sike, Silverkellwell, the Lunehead Mines (several veins), Cocklake, Closehouse, Arngill, and Standards are in the Lune Forest and Lune Moor areas. There are, too, records of lead mining on Mickleton, Cotherstone and Hunderthwaite Moors, but before 1760 only for Hunderthwaite.

This inquiry into the structure lead production on Bowes estate during mid-eighteenth century can be dissected into three strands: the process of finding lead ore; the organisation of discovering and mining; and production and productivity.

The existence of Lunehead mines and Green Mines was not ignored by George Bowes, but in his era three forms of activity appear to have become more commonplace: exploration of the landscape on the Bowes estate in Upper Teesdale; prospecting, actually finding lead ore by trial under tack or lease, usually by trenching or initial hushing, bell pits, but sometimes levels and shafts; and, once the potential of the lead vein had been assessed, the more expensive exercises of driving levels or adits, and sinking shafts. It appears that prospecting for lead veins has received

negligible attention from historians of mining, an issue raised by Torrens.[337] The extant records give a general indication of how lead was discovered. Suffice to say that during the first half of the eighteenth century on the Bowes estate there were men who, apart from observation, had a basic knowledge of soil, vegetation, drainage systems, and landscape, but not geology, which was enough to discover lead veins on a trial and error basis. Regrettably, although discoveries on the Bowes estate are mentioned in agents reports and general correspondence, there are no details of how they were made. Consequently, to suggest more than the crude knowledge and skills already remarked upon could be misleading. Explorers and prospectors hunted for a metal that was found in veins, unlike coal that was bedded in strata. There must have existed, to some extent at least, within the limits of their existing knowledge and skills, an ability to predict.

Some detailed examples of discovering lead have been uncovered. In May 1729 John Tidy, a Bowes agent, wrote a letter of recommendation from Middelton in Teesdale to George Bowes to inform him that the Derbyshire partnership of Thornhill & Norman was carrying out trials in the northern Pennines under the direction of a Mr. John Buxton, who had already 'had great success in the Mines in Wales'. John Tidy had agreed with Buxton that Thornhill & Norman could take a tack on Green Mines, Black Ark, and Lunehead at one-sixth duty, and that regardless of any outcome they would pay for the trials.[338]

John Dent, a yeoman from Dufton in Westmoreland, discovered the lead vein at Isabella-mae-Hill in September 1740, which he reported to a Bowes agent who immediately inspected the source on Mickle Fell. Consequently, George Bowes made an agreement with Dent, and within less than a year of the find the scale of

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[337] Torrens, *British Geology*, ch. 1.
[338] *D/St/C4/1/1 (2)* dated 30th May 1729.

mining there developed from open cast to the sinking of shafts.[339] This ore was assayed for both lead and silver by John Gibson, the man who eventually became the Bowes' smelt mill manager.[340] Similarly, on 30th April 1741 William Horn and Edward Rain discovered 'a hopefull Tract of Grownd near Mickle Fell for a Lead Myne north of Long Crag'. George Bowes or his agent granted them a twenty-one year lease that same day at Streatlam Castle, with Bowes himself taking a half share with strict terms for Horn and Rain and their three partners Thomas Horn, William Robinson, and William Robson.[341]

Occasionally experienced miners would approach Bowes agents seeking permission to wander and explore an area of land in the hope of discovering a vein which could lead to a trial. In 1750, Thomas Colpitts I wrote from Upper Teesdale to George Bowes in Hanover Square, London that 'Watson (the Husher) with another person came here and asked for a tack to make trial for one year at 1/6th duty, and then if demanded, to have leave for 14 or 21 years at 1/5th, according to the method used in granting Tacks and Leases, and be subject to such other usual Covenants as are contained in Leases for Lead Mines. They do not seem to know at present any certain place, but asked to have room to seek about, and be obliged to keep clear of any of the veins at Is.-m-hill or Green Mines. From what I cd. Gather, they have an Eye on something about Long Crag.'[342]

A Bowes agent, wrote to Mr. Cleaver, Lord Carlisle's agent at Castle Howard, from Mickleton on 26th December 1749 during his visit to Crinkle How,

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339 *D/St/B2/15* the agreement between Dent (for a quarter share) and Bowes for seven years, and *D/St/B2/103* a report of the inspection by an unknown author.

340 *D/St/C2/3/77 (5)* letter from John Gibson to Richard Stephenson.

341 *D/St/B2/16* a lease between Bowes and five adventurers or miners. The terms are discussed below in the comparative analysis of leases arranged during the seventeenth and eighteenth centuries by the Bowes.

342 *D/St/C2/1/5* Thomas Colpitts I to George Bowes 15th February 1750.

over 1700 feet above sea level on the southern edge of Holwick Fell, complaining of staying 'in this dismall part of the world'. He was there following a visit from Mr Cleaver to assess the work required in tracing the lead vein prior to a full exploratory trial. This correspondence juxtaposes the optimism and exasperation involved in the search; the hope of discovering high yielding lead ore, preferably silver bearing, set against the harsh reality of drifting and sinking, the cost, and high risk of failure. The correspondent's narrative crystallizes the nature of lead mining in the mid-eighteenth century:

'The Levell Drift cannot be carryd above four Fathom further without another Shaft, and then if we pursue the method hitherto practised, the Levell must stand still whilst a new Shaft is a sinking. At which rate the Tryall intended to be made, may be prolonged for seven years longer before we can be one jot wiser than at the present. ……..not doubting, but you will be of the opinion that that the sooner we know our Doom, the better. After sinking the next Shaft, and when the Levell shall be carryd beyond it as far as the Air will allow the men to work, We may then set about to make Trials, and whether we meet with a new Peru, or otherwise, it will at least serve as a Beacon to guide all future Generations from splitting on that rock'.[343]

George Bowes' stewards were instructed to search for lead veins whilst carrying out their managerial functions in the field, and were not averse themselves to becoming mine adventurers. Thomas Colpitts I wrote in 1750 that he 'shall go for Gibside, carry the cash I have left, and then return hither, where I prepare to range among the Mountains, and if I stumble upon an unexplored vein, I may be tempted to invest a little money that way, having as yet no family to take care for, and may as well waste a little money, not a deal as in any other'.[344]

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[343] *D/St/C4/1/3* letter from a Bowes agent (probably Thomas Colpitts I) to Mr Cleaver at Castle Howard near York.

[344] *D/St/C2/1/5* being Thomas Colpitts I's letter to George Bowes of 15th February 1750.

In addition to exploration and prospecting on the Bowes estate, George Bowes also received reports and offers by way of insider information about potentially lucrative lead mines elsewhere in the North Pennine orefield. For example in 1758 one Joseph Bowes wrote to him on behalf of Joseph Emmerson regarding 'some Leadmines in the Duke of Bridgewater's possession'. Joseph Bowes described Emmerson as a mining expert well known to the agents of the Earl of Darlington, for whom he had worked at Pikelaw, and generally held in good esteem in the lead mining fraternity. The letter stated that Emmerson believed the remaining eighteen year term on a lease at Scoregill near Dufton was 'the most promising thing that any Gentleman can chance money in ……'. He considered it of particular interest to George Bowes because it was only ten miles from his own smelt mill at Wemmergill.[345] There is no record of George Bowes' response to this opportunity.

The organisation of exploration, discovery, and mining of lead on Bowes lands was embodied in tacks and leases, the numbers of which are an indicator of the general growth in lead mining. George Bowes granted twenty-two tacks and leases, with terms varying between one and twenty-one years. In the late 1720s and 1730s there was a tendency to offer one-year tack notes with options for twenty-one year leases, usually for exploratory activity in specific, but limited, geographical areas. During the 1740s leases of ten years or less became the norm, and all of these were for established mines or mining areas. The tacks and leases granted in the 1750s were either under five years or for twenty-one years, but again all but one were for mine workings that had been operated and developed in the previous twenty years. There does not appear to be any identifiable pattern in the terms granted

[345] *D/St/C2/3/75 (6)* being a letter from Joseph Bowes to George Bowes, but there is no suggestion that Joseph Bowes was a relative.

to lessee adventurers; their view of any particular mine or potential mine will have determined negotiations with George Bowes agent, who advised his master and in return applied instructions accordingly. In most cases duty ore was one-sixth bing to George Bowes, but even then caveats applied, as the comparative analysis of leases below will reveal.

The list of tacks and leases in Table 2 below provides clear indication that lead production was taken much more seriously during the George Bowes era, particularly during the 1740's and 1750's. Again, it may be that some manuscripts for this period did not survive, but there is sufficient evidence contained therein to establish the structure of mining activity on Bowes lands in Upper Teesdale.

TABLE 2

List of Tacks and Leases for Lead Mines on Bowes Land 1727 – 1756

Date	Term	Lessee(s)	Field/Mine	Duty Ore
1727	21 yrs	Ferdinando Huddleston	Hunderthwaite	1/8th
1738	1 yr 21 yr option	Thomas Taden Jonathan Watson & Co	around Wemmergill & Arngill Beck	1/7th
1738	1 yr 7 yr option	John Longstaff & Co.	Mase Beck area (covering Green Mines and Isabell mea Hill)	1/6th
1741	21 yrs	William Horn Edward Rain	north of Long Cragg near Mickle Fell	1/5th
1741	7 yrs	Jonathan Watson Thomas Tedding	Standards	1/7th
1742	4 yrs	Robert Hind Nathan Horn John Dent	Arngill	1/6th
1744	10 yrs	Robert Dent John Bedell	Closehouse	1/6th
1744	noted as in tack	Thomas Tedding Thomas Rain Jonathan Watson John Langstaff	High Hush at Lunehead	1/6th
1744	ditto	John Dent John Robinson	Low Hush at Lunehead	1/6th
1746	7 yrs	Charles Wensley (forfeited by 1748)	Level Head at Lunehead West	1/5th

			to Silverkellwell	
1747	3 yrs	Ned Robinson	Closehouse	1/6th
1748	2 yrs	John Dent of 'ye Gate' Robert Dent John Shield John Dent of Scarthead	Arngill	1/6th
1748	5 yrs	Jonathan Watson Thomas Tedding	Standards	1/6th
1752	21 yrs	Charles Wensley	Rowton Syke at Lunehead	1/6th
1754	5 yrs	Charles Wensley	Old Field east of Mine Hill, Lunehead	1/6th
1754		Tim Bainbridge John Bainbridge William Tarn	Isabell mea Hill	not found
1754	1 yr 21 yrs option	Samuel Bacon	Standards	1/6th
1755	21 yrs	William Dockray Joseph Cradock William Watson John Cradock Anthony Cradock	Green Mines Quorgill Hush Langstaff Hush	1/6th
1755	1 yr 21 yr option	Thomas Pierce (option not taken)	Area of Mickle Fell, with Nichol Hopple Yard	not found
1755	3 yrs	Jonathan Watson	Closehouse	1/6th
1756	2 yrs		Black Ark	1/6th
1756		Nicholas Furnice	Sun Vane at Closehouse	
1756	21 yrs	George Tissington	Nickle Hopple Yard & areas of Mickle Fell, Black Sike, White Pitts Near Noon Hill, & Silverkellwell to be assigned by Bowes to Tissington. All for lead and copper.	1/6th

Source:
Extracted from *D/St/B2/11-31; D/St/B2/105, D/St/B/21; and D/St/B/32*.

After being originally worked by Bowes, Green Mines, Standards, Arngill, Closehouse, and various veins at Lunehead were all developed and worked by others through tacks and leases. The mines at Standards, Arngill, and Closehouse were all worked by various miners under different leases during the 1740s and 1750s. There were six leases for the veins at Lunehead, but the winning of lead ore in the veins at Lunehead was largely in the hands of Charles Wensley from1746,

particularly at Rowton Sike. The mine at Rowton Sike, where he was eventually offered a partnership by George Bowes, was leased to Charles Wensley for twenty-one years in 1752.

TABLE 3

Lead mines Operated by Bowes or in partnership listed by earliest date & record type

Mine	Date(s)	Type of Record

Arngill	1741	Pay bill (see Isabell-mea-Hill)
Birkdale (formerly Isabell mea Hill)	1758	Report[346]
Black Ark	1757	Memoranda [347]
Black Sike	1746	Memorandum[348]
Closehouse	1731	Pay bill[349]
Cock Lake	1758	Pay Bill[350]
Crinkle(d) How	1748-49	Pay bill[351]
Cronkley	1741	Valuation of tools[352]
Green Mines	1741	Expenditure account[353]
Isabell-mea-Hill	1740	Accounts ledger[354]
Lunehead	1730-32 & 1739	Expenditure & sales accounts[355]
Nickle Hopple Yard	1741-42	Pay bill[356]
Silverkellwell	1753 & 1755	Tack note & lease[357]
Standards	1737	Pay bill[358]
Source: *D/St/B2/70,93,103,105,117,119,121,127, &146.* See footnotes 32-44 below		

George Bowes operated mines both in his own right and in partnership. The number is quite impressive bearing in mind the risk involved in lead mining compared to coal. These mines are listed in Table 3 above and identified in the

[346] *D/St/B2/93 (4)*, reports and memoranda 1756-61
[347] *D/St/B2/93* memoranda and reports on the workings of various mines dated 1756-1761.
[348] *D/St/B2105*, memorandum regarding 'grove tacks' 1747
[349] *D/St/B2/117* a pay bill for Closehouse mine dated December 1731.
[350] *D/St/B2/127* paybill.
[351] *D/St/ B2/121* pay bill for Crinkle How lead mine 29th September 1748-14th December 1749.
[352] *D/St/B2/134* valuation and list of tools at Lunehead, Cronkley, and Isabell-Meah-Hill mines 1741.
[353] *D/St/B2/103* miscellaneous accounts, including expenditure on trials at Green Mines.
[354] *D/St/B2/105* accounts ledger covering the 1740s.
[355] *D/St/B2/146* account of Viscount Vane with George Bowes and John Buxton for ore from Lune Head, 17th August 1730 – 12th May 1732.
[356] *D/St/B2/119* pay bill for Nickle Hopple Yard lead mine, 15th May 1741 – 30th November 1742.
[357] *D/St/B2/70* a one year tack note between the Earl of Thanet and George Bowes; and D/St/B2/71 a twenty-one year lease between Sackville, Earl of Thanet Island and George Bowes.
[358] *D/St/B2/117* pay bill for Standards mine 6th August 1737.

estate records by the year or period of years specified in any particular document regardless of the content of the document, but of course this does not necessarily mean that a mine was in operation either before or after the date(s) stated in Table 3. Furthermore, at different times and different reasons Bowes leased some of these mines to others willing to risk their money.

Bowes instigated exploration, prospecting, and mining proper from the early 1730s, at Closehouse, Lunehead, Cronkley, Green Mines, Standards, and Isabell-mea-Hill, and of these only Isabell-mea-Hill remained in his hands, except between 1754 and 1758. In the late 1740s he and partners attempted to open a new mine at Crinkle(d) How, and to develop Black Sike. During 1747-48 Black Sike mine was also a partnership consisting of George Bowes, Edward Gilbert, Elizabeth Bowes (sister), Jonathan Watson, the most frequently recorded husher, and John Robinson.[359] Another partnership existed at "Lunehead mines" in 1740 and 1741 where there were different levels in operation at various times., and its shares were in sixteenths.[360] George Bowes granted a lease in 1741 for a mine north of Long Crag, probably what is now known as Millings Shop, where he held a half share, William Horn and Edward Rain one-eighth each, and three others a twelfth each.[361] The partnership with Charles Wensley at Lunehead began in 1755, for which there are records of pay bills for the partnership for the 1750's, demonstrating the commitment Bowes made.[362] Nichol Hopple Yard was a partnership mine from outset in 1741 and for the next two years, with George Bowes owning five-eighths, but it was let

[359] *D/St/B2/ 108* is Edward Gilbert's account for expenses at Black Sike mine in December 1747, and *D/St/B2/158* contains a list of shareholders for this mine together with some accounts.
[360] *D/St/B2/102* is an account for Reverend Mr. Thorpe's sixteenth share of income and expenses drawn up shortly after his death. There is no mention of the any other partners.
[361] *D/St/B2/16* the lease, and *D/St/P15/5* sketch map indicating Millings Shop.
[362] *D/St/B2/122* incorporates a collection of pay bills for various mines, including Rowton Syke.

in 1755.[363] Black Ark was a known as a potential source of lead ore in 1729, but it was

not mined until it was let in 1756, then returned to Bowes hands in 1757.[364] George Bowes also instigated the Cock Lake workings in 1758.[365]

Silverkellwell must have been assessed as having good potential, because this is the only mine leased by Bowes from another mineral lord, the Earl of Thanet; he took the lease for twenty-one years in 1755, after trial workings conducted under a one-year tack note of 1753. Ultimately, there was a long-term legal dispute between the Bowes and Thanet, when in fact there was very little lead ore to argue about.[366]

The number of mines, whether leased to miners or adventurers, worked by Bowes and partners, or operated solely by him, gives an indication of the importance and potential value of lead to George Bowes. There is evidence of greater and more widespread activity compared to the earlier period. Table 4 below lists the mines and indicates the chronology of activity, regardless of who actually worked the mines at the time.

There are thirty mines and mining areas documented for the period 1727 – 1760, of which lessees only operated twenty-five at different times, six by George Bowes and partners, and eleven by George Bowes himself. Before he inherited the estate, only two of these mines were operated by the Bowes family, namely Green Mines and Lunehead, where different levels and shafts were worked at different times by different parties. Only Green Mines can be identified as having Bowes family involvement before George Bowes initiated a positive change in the

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363 *D/St/B2/5/119* and D/St/B2/105, both paybills.
364 *D/St/C4/1/1 (2)* which are correspondence to Bowes 30th May 1729, and *D/St/C2/3/76-77*.
365 *DSt/B2/127* a record of lead ore to the smelt mill in 1758.
366 *D/St/B2/73-80* include records relating to the dispute which continued until the end of the eighteenth century.

process of exploitation, transforming it from an almost haphazard and incidental activity, an occasional by-product of landownership, into a more structured local industry that he directed and organised.

TABLE 4

List of Mines/Workings Indicating Chronology of Activity and Category of Operator

	Lessee	Bowes & partners	Bowes only	Pre Bowes
Arngill	1742		1741	
Arngill Beck	1738			
Birkdale (Is –m-Hill)			1758	
Black Ark	1756		1729 &1757	
Black Sike	1756	1747		
Bradwood Rains				1689
Closehouse	1744,'47,'55		1731 &1751-55	
Cock Lake			1758	
Crinkle How		1748-49		
Cronkley	1756	1741		
Green Mines	1755		1729,'41,'51-55	1679, '92
Greenfell Common	1711			
Hunderthwaite	1727			
Isabell-Meah-Hill	1754	1740-42	1742-54	
Longstaff Hush	1755			
Lunehead		1740-4	1730-32,1739	1657
Lunehead (Sun Vein)				1687
Lunehead (area S.East)				1705
Lunehead (Level Head)	1746			
Lunehead High Hush	1744			
Lunehead Low Hush	1744			
Lunehead Little Street			1759	
Lune, Howick, & Lonton (areas of moor)				1709
Long Crag	1741			
Mase Beck (area)	1738			
Micklefell (area)	1756			
Nichol Hopple Yard	1756		1741-42	
Rowton Syke (Lunehead)	1752	1755		
Silverkellwell			1753 & 1755	
Standards	1741,'48,'54		1737	
Quorgill Hush	1755			
Wemmergill (area)	1738			
White Pitts (Noon Hill)	1756			

Source:

Table IV is derived from Tables 1,2, and 3. The author's understanding of the Maise Beck area lease of 1738 is that it probably included what would otherwise become known as Green Mines and Isabell-mea-Hill. It was granted for the purpose of general exploration and workings. Also, Quorgill and Langstaff hushes were part of Green Mines as the orefield developed.

The unpredictable nature of lead mining, largely caused by geological

conditions, entailed regular re-assessment of viability. Table 4 above reveals this changeability and consequent variations in who operated the mines from time to time. George Bowes would decide to continue or cease operations, introduce partners, or grant leases. There are several examples of this process. Closehouse was a Bowes' mine in 1731, but was leased in 1744, 1747, and 1755. In 1679 Green Mines was leased for twenty years to partners including two members of the Bowes family, but in 1692 it was leased to another partnership. In 1741 it was re-opened by George Bowes, then in 1755 let for twenty-one years to another adventurer.

Lunehead, the generic name for the place where various types of mining activity occurred along the different veins, was first worked under a tack note in 1657, was operated by George Bowes during 1730-32 and again in 1739, but early in the 1740's he brought in partners to fund the development of this mine. The initial work at Standards mine was carried out by Bowes in 1737, but was later leased out a different times during the 1740s and again in 1754. George Bowes opened Closehouse mine in 1731 and again 1752/3, but it was worked under lease from the mid-1740s, and again from 1755. In 1758 Bowes began exploratory work at Cocklake, but to little end.

The search for lead and actual lead mining appears to have intensified during the 1730's, 1740's, and 1750's.Unfortunately, there is no clarification about the longevity or scale of production of most of these mines, but Tables 3 and 4 provide broad indication for some. Closehouse was active in the early 1730's and the mid-1740's and 1752/3, whilst Green Mines witnessed activity at different times from the late 1670's, and was re-opened in the early 1740s and the mid-1750s. The two key mines operated by George Bowes with partners were Isabell-mea-Hill during 1740-42, until his partner John Dent died in 1742); and Rowton Syke from the mid-1750s.

Silverkellwell became a new focus for new mining activity in the mid-1750's, but the lease was assigned to another mining adventurer in 1756.

The leases, tack notes or licenses, pay bills, and expense accounts documents examined and itemised in Tables 2 – 4 point to on-going lead mining, but only intermittent periods of more intensive activity during the period 1727-60. Memoranda exchanged between George Bowes and his agents regarding leases and the progress of mine workings provide further clarification of when many of the abovementioned were in operation. Arngill was working in 1746, was leased out for the two years from 1st September 1748, became available again for letting in August 1751, was noted by Bowes' in projected ore production figures in 1754, and was still being worked in 1756.[367] Closehouse mine was leased for three years in 1747, was taken on by one Jonathan Watson in 1751, remained in production during the 1750's, and back under Bowes control in the latter years of this decade.[368] Black Ark mine also came into operation under the sole control of Bowes in the late 1750's.[369]

It has been possible to show when and where lead mining was carried on by George Bowes, he and partners, or lessee miners and adventurers but what was the nature and extent of the mining activity? By merging the content of the tacks and leases with a broad selection of memoranda and correspondence about activities at the various mines between 1729 and 1760, the different methods of getting ore from the ground – hushing, levels, shafts - and therefore the physical development of the mines over time can be clarified.

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[367] *D/St/B2/81* account of duty ore delivered from Arngill mine; *D/St/B2/21* George Bowes' handwritten memorandum dated 20th August 1748; *D/St/B2/21* George Bowes' handwritten memorandum dated 16th August 1751; and *D/St/B2/93* memoranda and reports on various mines for the period 1756-61.

[368] *D/St/B2/21* Bowes memorandum of20th August 1748; *D/St/B2/22* Bowes memo; *D/St/C1/3/58 (4 &5)* letters between Bowes and his agents 1737-1754; *D/St/B2/93(1,3 & 4)* memoranda and reports on various mines 1756-61; *D/St/ C3/76 (9 & 12)* letters between agents 1751-1765.

[369] *D/St/C3/76 (1,6,8,11),* letters between agents; and *D/St/B2/93 (1)* memoranda and reports 1756-61.

Some mining was begun and occasionally ore was extracted, but did not necessarily develop into sites of prolonged activity. Black Ark was known as a potential source of ore in 1729, yet George Bowes only began workings there in 1748, but to no avail. Subsequently, he leased it in 1755 to independent miners, but began working it again 1757. Some progress was made in the late 1750s when the mine was in Bowes hands; in1758 the miners were 'carrying up a level'; and in 1759 a 'strong vain' was reported containing ore 'which is promising but very hard', and in this level ore was found daily. Consequently, in 1759 the agent reported that he was expecting to have 'a good grove in one year's time' because he estimated that they were twenty fathoms from the ore.[370] There is no evidence of mining here after 1759. Clearly, the cost of working Black Ark was beyond the financial capabilities of any individual or small group of lessees, so Bowes funded the dead work until ore was found, but then discontinued.

The initial work at Crinkle How in 1748 and early 1749 involved sinking and driving, and by 1748 there was the original shaft and a level drift, and the Bowes agent believed a new shaft was required.[371] Mining was discontinued and there are no records of ore production, yet the indications appear to have been good for the two wealthy partners, George Bowes and Lord Carlisle.

The ground north of Long Crag, possibly what became one of what are now known as either Nichol Hopple or Silver Band or Milling's Vein, was let to two partners in 1741 and the sinking of a shaft is mentioned in the lease. It is not described in the same way again in any later leases and there are no records of ore won there.[372] Similarly, George Bowes did not develop Silverkellwell mining beyond

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[370] Black Ark details are from Tables 2 –4 and *D*/St*/C2/3/76-77.*

[371] From *D/St/B2/121 and D/St/C4/1/3.*

[372] *D/St/B2/16,* and if it was Milling's Vein it appears on a 1793 sketch map of Green Mines *D/St/P15/5.*

the exploratory shallow shafts in the mid 1750s.[373]Again, there is no evidence of any ore extracted. In 1756 a lease was granted for prospecting in ground at White Pitts on Noon Hill, but it appears to have been abandoned or ignored without discovering any lead ore.[374] At Nichol Hopple between 1741 and 1743 Bowes drove a level, then let areas of ground away from the first shaft in 1755 and again in 1756.[375] Lastly, Black Sike was originally hushed 1747/48 when George Bowes and partners owned it. It was let in 1756 for exploration of 1000 yards by 400 yards of ground, and appears to have been back in Bowes' hands in 1758 when a low level drift existed and 'sum pieces of oar' had been found.[376]

In summary, the mining activity and the expenditure incurred at Black Ark, Black Sike, Silverkellwell, White Pitts, Crinkle How, north of Long Crag was serious prospecting using methods already described, but largely unproductive and assessed as unworthy of any further development before 1760, because the vein was not traced, or the ore content was reckoned poor quality, or because more risk capital was unforthcoming in current market conditions.

Several other mines in more productive veins on the Bowes estate were developed to a much greater extent by both Bowes and lessees. This is evidenced by the growth of systems of shafts and levels, as well as continued hushing in some places, the prerequisite for all of which was the willingness to spend money. The mines at Closehouse, Green Mines, Isabell-mea-Hill, later Birkdale, and Lunehead were all sites of relatively intensive extraction; Isabell-mea-Hill and Lunehead during the 1740s and 1750s,and Closehouse and Green Mines mainly in the 1750s. The growth of these mines continued in the late eighteenth century and throughout the first

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[373] *D/St/B2/30 and D/St/B2/73-75.*
[374] *D/St/B2/30*
[375] *D/St/B2/28,30, 105, and 119.*
[376] *D/St/B2/30 and D/St/C3/2/76.*

half of the nineteenth century , largely in the hands of the London Lead Company from 1771 in the cases of Closehouse and Birkdale. At Closehouse in 1751/2 the paybill was mainly for the winning of lead ore, followed in 1752/3 by further sinking and drifting using timbering. Ore was struck again, and the 1753/4-pay bill was mainly for extracting ore by the bing. After Closehouse was let in 1755 another shaft was sunk.[377] Bowes began sinking and drifting at Green Mines in 1751-52, a further shaft was proposed in 1752 and fathom work continued in 1754-55 but no ore was struck. Two areas of ground were let either side of the vein in 1755,and in 1758 ore was found, but not the main vein. In 1760 hushing continued at Green Mines.[378] Isabell-mea-Hill was a highly productive lead mine during the 1740s in Bowes' ownership with a subterranean system of shafts, levels, and cross -cuts. Sinking and drifting continued throughout the 1750s, and hushes were also used and are identified in records for 1754 and 1759.[379] Lunehead mines worked various veins as we have already established. Bowes began the driving of levels and sinking of shafts in the 1730s, and in partnership during the early 1740s he continued the sinking through limestone. Between 1746 and 1748 the lessee Charles Wensley created more shafts and levels, including at Rowton Sike, where hushing was undertaken in 1751, and where Bowes eventually became his partner in 1755,. In 1754 quality ore was found and another shaft was sunk, and in the following year a lead vein ten feet wide was discovered. Lead mining was still ongoing here in 1757.[380]

The discovery of lead veins and following them successfully by sinking shafts and driving levels to extract ore was a painstaking task which

[377] For Closehouse sources *D/St/B2/93,117,* and *122*.
[378] For Green Mines sources *D/St/B2/23,29,* and *122*, and *D/St/C2/3/58* and *76*.
[379] For Isabell-mea-Hill sources see *D/St/B2/92-93,105,* and *122; D/St/C1/3/58;* and *D/St/C2/3/75-76.*
[380] For Lunehead sources *D/St/B2/19, 21, 24, 101,* and *122; D/St/C2/1/5 and 21;* and *D/St/C1/3/58.*

demanded perseverance, investment, and a long term business view in terms of the mineral exploitation of the Bowes estate for financial gain. The description of the most productive or potentially productive mines above, the expansion of which continued after George Bowes death in 1760, and particularly after 1771 when they were leased out, confirms the timescale for dead work and winning lead ore on a continuous basis, often characterised by intermittent periods of no or little ore production. As mines became deeper in chasing the lode, capital expenditure increased, and George Bowes undoubtedly had the means to create continuity of extractive work at any of the sites mentioned. He appears to have taken up the challenge of exploiting certain known mines during the 1750s, either because lessees could no longer afford to, or because the potential of these mines was perceived as worth the commitment in the then current market conditions. Lead mining on the Bowes estate at this time was difficult and required an indomitable willingness to commit capital, skills, and management to the extraction of ore. Lead could be discovered and the veins followed, but when it would be exhausted was unknown, other than that this would definitely happen.

To what extent was lead mining a seasonal activity? The majority of tack notes and leases granted by George Bowes were dated in the second half of the year. The months of July, August, September, and October appear on most of the documentation.[381] It could be inferred from this evidence alone that mining was an autumn and winter activity for people otherwise engaged in agriculture; that lead mining adventurers took up agreements when the labour became free from the demands of the land and available to harvest another form of produce. There has been a selection of different views from historians regarding the farmer-miner or miner-

[381] *D/St/B2/11-31* tacks, leases and agreements for the period to 1760

farmer, the description being contingent upon the bias given to the primary role, but generally the former terminology is used for the sixteenth and seventeenth centuries. Joan Thirsk referred to 'mineral-yielding areas' where 'industry and agriculture were ancient bedfellows', and 'semi-industrial communities' in which under-employed people primarily involved in agricultural pursuits became involved in some form of industry, including the extractive industries, such as lead, tin, and iron mining.[382] This view was more recently transplanted in an entrepreneurial context to embrace the late medieval period and the early sixteenth century; landowning gentry employing an under-employed agrarian labour force as an alternative investment in the financial potential of mineral extraction, rather than agricultural improvement.[383] The argument for an 'industrious revolution' amongst the agricultural workforce intent upon earning a supplementary income was introduced by de Vries; 'the industrious revolution was a process of household-based resource allocation' fundamentally rooted in the aspirations of the family unit.[384] The extent of the farmer miner's commitment to metal mining was reconsidered by Blanchard in terms of work psychology i.e. conscious behaviour to achieve a particular level of required income.[385] Blanchard maintains that before 1600 lead mining was a dry, summer season activity, because the technology for draining mines did not exist, but that after 1600, when adits were in more general use for relieving the problem of mine drainage, it was no longer restricted to the summer months. The underlying motivation for mining was the desire to earn 21s per annum, the labour intensity to produce which was determined by the level of rents and the price of lead.[386] A more

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[382] J. Thirsk, 'Industries in the Countryside', in Fisher, F.J. (ed.) *Essays in the Economic and Social History of Tudor and Stuart England* (Cambridge 1961) pp.70-88.
[383] Dyer, *Making a Living*, pp.341-345.
[384] de Vries, 'The industrious revolution', pp.249-269, quoted from p. 249.
[385] Blanchard, 'Labour Productivity', pp.1-24
[386] *Ibid*. pp. 2-3. Blanchard takes as one of his exemplars farmer-miners in the northeast of England,

recent study of rural life and agrarian economy identifies the extractive industries as an important development and source of improving wealth in upland communities, but does not explore the role of the farmer-miner or the seasonality of metal mining.[387]

There is a broad selection of mining reports and memoranda between George Bowes and his stewards and agents in the field, and between agents and stewards at Streatlam and Gibside. The dating of these documents establishes the chronology of workings at various mines and mining areas, and their contents serves to elucidate upon the seasonality or not of lead mining on the Bowes estate in Upper Teesdale. Closehouse was being worked from October to December 1731;[388] Standards during the first half of 1737, and miners were paid in August that year; [389] and at Lunehead between October 1739 and February 1740.[390] In February 1741 Lunehead and Isabell-mea-Hill were working,[391] and in November that year Arngill, Isabell-mea-Hill, Lunehead, and Standards were active;[392] Nichol Hopple Yard was mined at least between May and November 1741,[393] whilst mining appears to have been continuous at Isabell-mea-Hill and Green Mines at least from July to November.[394] Mining went on at Lunehead and Isabell-mea-Hill during the winter months of late 1741 and early1742.[395] Crinkle How was mined from September to December 1749.[396] In 1750 it was reported that Standards, Arngill, and Closehouse were not being worked properly because 'the tenants who had them hitherto have not

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and in particular Weardale miners.

387 A.J.L Winchester, *The Harvest of the Hills: Rural Life in Northern England and the Scottish Borders 1400-1700* (Edinburgh, 2000) ch.1.

388 *D/St/B2/117* pay bill or this mine

389 *D/St/B2/117* pay bill for this mine

390 *D/St/B2/101* Matthew Dent's bill of charges for George Bowes

391 *D/St/C2/1/5* Nathan Horn to Thomas Colpitts I 10th February 1741.

392 *D/St/B2/118* pay bill for these mines

393 *D/St/B2/119*

394 *D/St/B2/103* Nathan Horn's accounts for pay and materials July to November 1741

395 *D/St/C2/1/5* Nathan Horn to Thomas Colpitts at Streatlam 10th February 1742.

396 *D/St/B2/121*

pushed on the workings so briskly…only employing the vacant time they had to spare from their other Business'.[397] The work at Green Mines had stopped early in 1750 because of severely bad weather but was to continue once it improved.[398] In January 1748 work in the levels and shafts progressed at Isabell-mea-Hill, and at Crinkle How the miners were expecting to 'cut the vein before midsummer day first'.[399] In January 1754 work at Rowton Sike, Standards, Closehouse and Isabell-mea-hill was making progress.[400] Ore was found in May 1754 at Rowton Sike, Green

Mines employed ten men, and ore was also wrought at Isabell-mea-Hill, Standards and Closehouse.[401] In February 1755 the middle vein was cut from Rowton Sike at Lunehead.[402] In October 1756 work was reported at Closehouse, Standards, and Arngill.[403] Early in 1758 mining was carried on at Rowton Sike, Black Ark and Isabell-mea-Hill,[404] and at Closehouse, Isabell-mea-Hill, and Black Ark early in1759.[405]

Isabell-mea-Hill, Closehouse, and Black Ark were being mined in autumn 1759.[406] The early months of 1760 saw mining at Isabell-mea-Hill, Green Mines, and Black Ark.[407]

Lead mining was carried on mainly during autumn and winter months, which leads to the conclusion that it was not a full time activity for most of those employed in it. Mining at Isabell-mea-Hill was the exception, particularly in the 1740s, when at times it continued into the summer months. Bowes invested in the

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397 *D/St/C2/5* Thomas Colpitts I to George Bowes 15th February 1750.
398 *D/St/C2/5*
399 *D/St/C1/3/58* Nathan Horn to George Bowes 31st January 1748.
400 *D/St/C1/3/58*
401 *D/St/C1/3/58* Nathan Horn to George Bowes 24th May 1754.
402 *D/St/C2/1/5*
403 *D/St/B2/93* probably a Richard Stephenson memorandum
404 *D/St/C2/3/76* Nathan Horn report to Richard Stepehenson 12th March 1758
405 *D/St/C2/3/76* Nathan Horn report to Richard Stephenson 2nd April 1759
406 *D/St/C2/3/76* Nathan Horn report to Richard Stephenson 5th October 1759
407 *D/St/C2/3/76* Nathan Horn report to Richard Stephenson 23rd Jun 1760.

building of a shop to house miners throughout the year near the mine workings, thereby managing the workforce in an isolated place to ensure they remained focused on their task. Mining activity on the Bowes estate tends to support the view that by the end of the early modern period it was no longer a summer occupation, and the the incidence of adits and levels suggests that the problem of mine drainage was being addressed at this stage, that general mining practice had been adopted.[408]

We have seen above that the extent of mining activity and the methods were unchanged from earlier times; sinking shafts, driving levels, and hushing were the most efficient methods of reaching the lead ore, with the latter clearly the cheapest.[409] What of the techniques and technology during the middle third of the eighteenth century on the Bowes estate, and did George Bowes introduce new technology? The records, including maps drawn by both George Bowes and his stewards, depict the methods of getting lead ore and the technology involved as very similar to lead mining in other areas. It is worthwhile to attempt an identification of the phase of technology and technique exisintg on the Bowes estate by 1760.

The tools used by lead miners remained as simple as in the sixteenth and seventeenth centuries. Estate documents, including mine pay bills and smelting costs, are littered with details of valuations and costs of tools, and those written by field agents often refer to techniques. In 1741 a valuation of tools was noted at

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[408] K. Wrightson, *Earthly Necessities: Economic Lives in Early Modern Britain (Yale 2000)* p.69 describes the working pattern of farmer-miners as seasonal, small scale, and based on rights of exploration and extraction, but there is no evidence of such rights on Bowes lands.

[409] For mining techniques and technology see G. Agricola, *De Re Metallica,* translated by H.C. Hoover, & L.H. Hoover, (New York 1950); C. Singer, E.J. Holmyard, A.R Hall, & T.I. Williams, *A History of Technology,* Vol. III (Oxford 1957); R. Hunt, *British Mining* (1887); Raistrick & Jennings, *History*; R. Burt, *A Short History of British Metal Mining Technology in the Eighteenth and Nineteenth Centuries* (De Archaeologische Pers Nederland1982); and R. Burt, *A Short History of British Ore Preparation Techniques in the Eighteenth and Nineteenth Centuries* (De Archaeologische Pers Nederland 1982)

Cronkley, later known as Silverband mine, and Lunehead as part of George Bowes exercise in protecting his investment against loss.[410] They are the same simple tools used in the sixteenth and seventeenth centuries, such as kibbles and picks.[411]
Dressing

and washing equipment are also mentioned as expected, such as sieves and knockstones. Field agents describe boring and blasting, particularly where the rock was extremely hard. In the 1740s Nathan Horn carried out blasting with gunpowder in various shafts and levels at Isabell-mea- Hill.[412] In the 1750s at Rowton Sike, where the middle vein was described as being ten feet wide, blasting was also undertaken.[413]

In the deeper mines where Bowes or lessees had invested in the development of shafts and levels, the problem of ventilation needed a solution. In1741 Bowes and his partner John Dent installed fifteen fathoms of air boxes in a shaft at Isabell-mea-Hill.[414] Wooden trunking for ventilation purposes has been identified by Burt as an innovation when mining became deeper.[415] Bellows and pumps are also occasionally mentioned in this regard, and in Charles Wensley's lease of 1752 for Rowton Sike, part of the Lunehead group, Bowes granted him permission to build 'gins and engines' where required.[416]

Burt concluded from his studies of mining technique and technology, and ore preparation that, subject to local circumstances – the nature of mineralisation, the depth of mining workings, the existence of waterpower, and the scale of mining venture – during the period from the mid-sixteenth until the late eighteenth century much of the technique and technology changed very little, but that in some stages

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410 *D/St/B2/134*
411 *D/St/B2/104*, which refers to Isabell-mea-Hill in 1742.
412 *D/St/B2/120*
413 *D/St/C2/1/5*
414 *D/St/B2/104*
415 Burt, *Metal Mining*, p. 57.
416 *D/St/B2/24*

improvement and diffusion of those improvements did occur.[417] The evidence for lead mining on the Bowes estate corroborates Burt's view that the underground level and cross-cut to find the vertical lead vein were the 'mainstay of exploratory activity' up to 1800.[418] In other words, there was little change in technique and technology, and consequently no revolution in the lead production process on the Bowes estate.

Blasting with gunpowder is generally regarded as the most significant innovation, and this method was in use in the Upper Teesdale orefield. Gunpowder blasting was in general use in North Yorkshire and the Alston lead mining areas during the 1690s which countenances Burt's view that at times there was diffusion of technique and technology in metal mining.[419] There is no evidence of improved mechanisation or use of steam power in the Bowes lead mines before 1760, but the use of gins – which brought together manpower and animal power - for hauling and transport is recorded as noted above. Evidently, there was no need for mechanical innovation, and moreover, George Bowes must not have considered such improvements that may have been available as economically viable for lead mining on his estate. For example, steam power would have required coal as fuel, but peat was readily available whereas as coal could only have been supplied at great logistical cost to Upper Teesdale.

Essentially, manpower and the art of using basic tools occasionally assisted by explosives was the chief means of winning lead ore on Bowes lands in the mid-eighteenth century. The Bowes estate can be linked directly to contemporary technology and methods at Isabell-mea-Hill, and there is evidence of their use within the Lunehead group of mines, but the overall impression is that the lead mining

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[417] See Burt, *Metal Mining*.
[418] *Ibid* p.14.
[419] B. Jennings, *The Lead Mining Industry in Swaledale* (Unpublished M.A. Thesis, University of Leeds 1959) p.48. Also see W. Wallace, *Alston Moor: its Pastoral People, its Mines and Miners* (Newcastle upon Tyne 1890)

conducted by Bowes' small scale lessees was that described by Agricola in the sixteenth century, and later by Pryce and Hunt.[420]

In the search for lead ore on his estate, preferably silver bearing ore, did George Bowes, did his stewards and field agents demonstrate any knowledge of geology which they could apply to enhancing the process of discovery and extraction? The history of activity at the various mines during the middle third of the eighteenth century, when only the direct involvement of George Bowes produced any level of continuity, is listed above in Table 4. Discoveries were made, mining in different forms begun – hushing, trenching, shallow pits, shafts, levels – but in this period of greater activity the evidence suggests that in most cases the ability to predict the on-going discovery of lead ore did not exist.

The generally held view is that geological science was in its infancy during the eighteenth century and far from being a fully formed body of knowledge, and therefore incapable of being predictive. During the eighteenth century there was debate and investigation in earth science, in effect a continuation of a trend begun in the seventeenth century, but there was no 'geology' as such until the early nineteenth century. Furthermore, 'Most eighteenth century mining manuals also kept to existing traditions, rather than rejecting them. Indeed, this was their declared intention – the handing down of personal craft experience from generation to generation'.[421]

The level of then current knowledge is displayed to some extent in agents' reports to George Bowes regarding progress in mining activity, the most regularly mentioned being 'whin sill' in descriptions of the difficulties encountered cutting through igneous hard rock and the costs involved. Bowes mine stewards and field

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[420] W. Pryce, *Mineralogia Cornubiensis* (1778); Hunt, *British Mining*; and Agricola, *Metallica*.

[421] Porter, *Making of Geology* p.115. Porter argues that the British tradition contradicted German technical knowledge.

agents possessed some knowledge of rocks and strata, and consequently it is reasonable to represent these men as practical geologists, experts of their time in metalliferous mining.

The most detailed example of this is Thomas Colpitts I's report on Crinkle(d) How of 26th December 1749 to Mr Cleaver agent for Lord Carlisle at Castle Howard near York. This also contained a sketch of 'the Strata or Beds as they are now found at Crinklehow', which unfortunately did not survive. The report is transcribed below:

'Strata.

1. Clay and Ramble; thickness unknown and varys with the Rise or fall of the surface
2. Lime. 5 yards, Dips to the South, but did not come on till the third shaft went down, will thicken at the distance of another shaft, being the hills to the south rise apace, and this Bed dips into the hill. On this depends all our hopes.
3. Hazell. 5 Fa:1yd: This also will thicken, and if the Lime next above it prove a bearing Bed, then may the Hazell also bear.
4. Black Plate, or, Chiver. 5 Fa: very Rotten.
5. Hazell. 6Fa: 3 yd: very strong.
6. Black Plate. 3 Fa: wherein we now drive and will be out shortly we will sink under Lime, and the last Hazell will come on.

Below this last is another Lime, thickness unknown, but if the Beds above give any encouragement, may be sunk and wrought by pumps.
The vein strikes thro' the low black chiver exceeding strong, and much more so than when you last visit. The workings above ground show it very plain.
N.B. The range of the vein is from SW to NE reckonable favourable. Dip to the South'.[422]

This transcript discloses that knowledge of rock stratification did exist, and that there was more than a seed of an idea that it could be traced across the landscape in the search for lead ore. In addition, the content of the report shows terminology in common use – names of the different strata, beds, dips, vein. On balance, however, this example of practice on the Bowes estate does not necessarily

[422] *D/St/C4/1/3* letter from Colpitts to Cleaver.

mean that even some men had detailed knowledge of subterranean ore deposits and how they could effect the relief of the landscape. The majority of miners probably worked on the basis of outcrops, the mineral appearing in streams in different places, and the existence of certain types of vegetation, and all of this very limited knowledge having been largely assimilated orally through generations. In Upper Teesdale there was probably more local lore than science. The examples given earlier of ore discovery hint at traditional methods rather than any scientific approach.

The plain fact of the matter was that to find economically viable deposits of lode bearing ore, especially when old mine workings were re-opened for further discovery, the most suitable method for any chance of success was to dig deeper shafts, drive adits into where the vein was reckoned to be, make cross cuts, or recommence hushing. In other words, as we can see from the history of mining activity discussed above, largely characterised by repeated attempts to find ore at known potential sources, the only means of progress was to cut the ground, and penetrate the underlying strata, because the nature of mineralisation was simply unpredictable. Veins containing lead ore once found could change direction quite randomly; only by men willing to cut their way through dead ground was it possible to discover more lead deposits and assess the viability of extraction. Their knowledge above ground was based upon observation of the landscape, characteristics of vegetation and flora, visible strata, and surface erosion; below ground it was based upon trial and error, and oral transmission of past experiences. This cumulative knowledge formed the basis of lead mining on Bowes' land , but did not guarantee success.

The risk-takers, the mining adventurers, regardless of their scale of operations on the Bowes estate, including George Bowes himself, operated in the

uncharted nether world. Their challenge was to overcome the huge uncertainty of discovering productive lead ore, which could only be achieved by risking money. The history of lead mining during the mid-eighteenth century on the Bowes estate in Upper Teesdale identifies small groups of individuals who worked specific areas of ground or existing mines for short periods of time under tacks and leases from George Bowes. The ore they produced was relatively small in weight and usually their discoveries were exhausted in the short term, and lack of working capital precluded further exploration. George Bowes instigated initial work at several mines, Isabell-mea-Hill being the most lucrative especially during the 1740s, and continued the quest for lead ore during the 1750s though much less successfully. Any success he experienced was due to his willingness to introduce working capital where others could not, in the hope that potential would be realised sooner rather than later.

Mining was an important source of employment on the Bowes estate in Upper Teesdale, whether it was on a part-time or full-time basis. Examination of the surviving mines pay bills, which list the earnings of bargains for both individuals and groups of miners, do not present great enough detail about the numbers of men and women employed in either actual mining or the washing and dressing of ore before smelting. The ambiguous wording used by field agents who kept these records makes it impossible to calculate the numbers employed. For example, there are many entries that provide the name of a miner followed by the words ‘and partners’. Obviously, the omission of the number of partners means accuracy is out of the question. The prevalent view of historians of metalliferous mining is that a bargain in lead mining was anywhere from three to twelve men. Again, this range of how many

could be employed in a bargain only allows very broad estimates.

Bearing in mind the abovementioned caveats, it is possible to offer some indication of number employed at different times at various mines. As we have already seen, the Isabell-mea-Hill lead mine was the most productive during the 1740s, and for this very reason the pay bills were well kept and detailed. In 1741 there were 19 bargains, only two of which were with individual miners, which equates to 59 miners, assuming an average bargain was three miners ; in 1742 fifteen bargains, of which seven were with individuals, so 31 miners; in 1743 there were 27 bargains getting ore, so 71 miners; in 1744 fourteen bargains, of which twelve were individuals; in 1745 there were ten miners getting ore; in and 1746 22 bargains, of which sixteen were individuals, so 48 miners, and 10 additional workers.[423] Isabell-mea-hill was the main employer of lead miners during the entire George Bowes' period of management. During the early year of the 1750s the workforce was at a much reduced level. From December 1752 to December 1753 there were seven miners getting ore; four bargains and five men on day work for the period December 1754 to December 1755; and in 1755-56 one bargain only.[424]

The other mines when in Bowes' hands and not leased to other adventurers employed much smaller numbers of miners. Closehouse began in 1731 with five men on day wages, and when Bowes re-opened in 1751-52 five miners were getting ore, there were five men sinking another shaft in 1752-53, and thirteen miners winning ore in 1753-54. There were only seven miners working at Closehouse in 1755-56.[425] At Standards in 1737 there was only one bargain on fathomtale. Similarly,

[423] *D/St/B2/105* accounts book for 1741-45, and *D/St/B2/120* for 1746.
[424] *D/St/B2/122* pay bills.
[425] *D/St/B2/122* pay bills on a December-to-December basis, and December 1731 pay bill.

initial workings at Nichol Hopple Yard and Crinkle How were also on a small scale;

three bargains mined barren ground at Nichol Hopple in 1741; and six bargains, including three individuals were sinking and drifting at Crinkle How from late 1748 to December 1749.[426] Green Mines was worked 1751-52 by six bargains, including two individuals, all getting ore. At Rowton Sike only only six carried on work bargains in 1752-53, including two individuals, and in 1754-55 by four individual miners getting ore.[427]

This broad estimate of the numbers of people involve in lead mining does not include others who may have been employed in the washing and dressing of the ore, although it was the miners themselves who generally did this too. Isabell mea-Hill lead mine could have been an exception, because of the scale of mining conducted there by George Bowes, who was astute enough to know the importance of washing and dressing in the lead production process. The tacks and leases granted by George Bowes nearly always contained a clause to this effect. The washing and dressing of the extracted ore is discussed below, and the there is a comparative analysis of tacks and leases in chapter 4 above.

Having discussed the means of production, the process of finding lead ore, and the organisation of its extraction, productivity and production can be examined.

The lead vein at Isabell-meah-Hill, discovered in 1740 by John Dent, became the main source of ore production. Its discovery was followed by an inspection recorded in a memorandum dated 29th September 1740 which identified a

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426 *D/St/B2/119* pay bill for Nichol Hopple; *D/St/B2/121* pay bill for Crinkle How; and *D/St/B2/117* pay bill for Standards mine.

427 *D/St/B2/122* mines pay bills.

new mine on Mickle Fell which the author called 'Mea Hill'. It appears to have been Thomas Colpitts I who wrote "Nathan Horn & self let a bargain to Matthew Raine of Lower Wemmergill & partner to get 20 Bing of ore Dressed fitt for ye Lead Mill" paid at a rate of 2s per bing .[428] George Bowes committed himself hastily to the potential of this mine. A report of 23rd December 1741 remarks that this mine was "exceedingly good" and "full of oare above head", and that a level had been driven past the cross-cut shaft with "14 fathoms to go to Raisbeck shaft", and added that "its ordered to be followed night and day".[429] The report states that Nathan Horn made an account of all work at both Isabell-Mea-Hill and Lunehead led mines. The cost of work was noted at £23 1s 6d for the months of September, October, and the first half of November, and that £37 had been paid out on account, though not naming the payee. The Isabell-mea-Hill lead mine, which became known as Birkdale from the 1754, was the centrepiece of the George Bowes' lead mining operations, the source of inspiration for his financial commitment to and growing interest in lead. He partnered John Dent for approximately two years, because Dent was responsible for its discovery in 1740 but died in 1742. Isabell-mea-Hill lead mine is worthy of detailed examination because it demonstrates the operation of a productive mine, and in particular the capital involved as it developed during the 1740s.

The numbers working at Isabell-mea-Hill has already been indicated, that it was the main employer of all the Bowes mines is undoubtedly true, even at times when ore production fell. The continuity of mining manifests itself in the system of shafts which developed following John Dent's discovery and the original open cast workings. So, workings began 'at the open cast where the mine was first discovered', which was assisted by Jonathan Watson and partners hushing, and then

[428] *D/St/B2/90* memorandum concerning an inspection of a new lead mine with a note of expenses
[429] *D/St/B2/92 (1)* Report on the lead mines at Isabell-mea-Hill and Lunehead 23rd December 1741.

John Bell and partners sunk a shaft next to the hush. Subsequently, within a year or so of discovery various shafts existed; the cross-cut shaft; Stapple Shaft; Raisbeck Shaft; Vickers Shaft; Guys Shaft, and Robsons Shaft.[430] More importantly, Isabell-mea-Hill was producing ore from outset; the total amount is in Table 5 below, and the annual figures are in Appendix I.

The rapid growth of the shaft system is indicative of silver bearing or fertile, argeniferous lead veins, because sinking shafts was more difficult than driving levels into hill or valley sides. Put bluntly, the silver content would have greater value than lead, which made shafts economically viable.[431] John Gibson, who became a smelt mill manager for George Bowes in 1757, assayed Isabell-mea-Hill and Lunehead for lead and silver prior to the development of mining there.[432] Only one of the many lead mining records examined for the period 1727-1760 actually notes silver extracted.[433] None were found for silver resulting from the process of refining lead ore.

The pattern of expenditure at Isabell-mea-Hill, detailed in Table 5 below, is of particular interest, because it is the only clear cut example of its kind in the period 1740-1760 for a productive lead mine on the Bowes estate. During the 1742 and 1743 the cost of sinking and drifting, dead work, was between one-fifth and one quarter of the mining costs, falling by approximately half in 1744. The cost of extracting ore was between fifty and sixty per cent during the years 1742-44, because

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[430] This paragraph is derived from various documents; *D/St/B2/103* oar bargain book 1741; *D/St/P15/2* sketch map drawn by Nathan Horn in December 1741; *D/St/B2/104* estimates of charges; and *D/St/B2/105* lead mines accounts 1740-46.

[431] L. Willies in J. Day, & R.F. Tylecote (eds), *The Industrial Revolution in Metals* (Institute of Metals 1991) p. 86 supports this view, noting that in Cardiganshire in 1667 silver content increased the lead ore value by four hundred per cent.

[432] *D/St/C2/3/71* correspondence between John Gibson and the senior steward Richard Stephenson.

[433] *D/St/B2/120 (3)* a paper belonging to the pay bill for Isabella mea Hill', undated, but judging by the nature of the bargains for exploratory work probably of 1741/2.

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the vein was most accessible, and so production was greater than 1745-46, when this cost fell below forty percent of total mining expenditure. The cost of sinking and drifting rose, on the continuing wave of optimism, above thirty per cent of mining costs in 1745-46. Overall, the cost of dead work increased from one fifth to one third of mining costs in this short period, and changes in both this cost and the cost of timber appear pari passu.

The cost of wood for the structural framework, called 'grove wood', was always the lesser of the three itemised in the table, but could be described as capital formation in that it permitted future mining when the market for lead rather than pure optimism was the determinant of new work. Indeed, it could be

Table 5

The pattern of mining expenditure at Isabell-mea-Hill 1742-46

Year	Total on mining £	s	d	% grove wood	% sinking & drifting	% getting ore
1742	534	8	7	9.3	20.7	59.5
1743	357	14	11½	7.4	26.1	52.0
1744	310	17	11	8.4	12.7	58.7
1745	225	12	11½	10.2	30.5	38.9
1746	168	16	5	13.4	32.6	38.3

Source:

Derived from *D/St/B2/104-105* charges and accounts for Isabell-mea-Hill. It should be noted that mining costs include wood, sinking and drifting (fathom work, or fathomtale), getting ore (per bing of ore, or bingtale), and day wages (for fixing, mending and carrying in the mine shafts, stoop work, cutting water courses, and getting stones for the bingsteads). The aforementioned types of work are noted in accounts for Isabell-mea-Hill. Carriage costs of ore and lead, and any mill charges, have been excluded from the construction of this table.

construed that the costs mentioned here actually created the capital stock of this or any other mine. In 1742 George Bowes invested £82 2s 0d in the building of the first house at Isabell meah-Hill, which became known as the 'Old Shop', where miners lived during their working week.[434] In 1756-57 he invested in the building of a new smelt mill at Wemmergill; the details of this development in smelting of the Bowes estate are discussed below in chapter 6.

By 1752 George Bowes had lost interest in mining at Isabell-mea-Hill. This mine was known as Birkdale from 1754, but only became productive again after 1760. It was let to a partnership of miners in 1754 – John Bainbridge, Tim Bainbridge, and William Tarn – who had a contretemps with mines steward Nathan Horn over his alleged failure to provide agreed equipment and to pay them for lead ore which was sold to Andrew Appleby at Eggleston smelt mill.[435] In 1758 Bowes began working Birkdale again, following the success of hushing, and in April 1759 Nathan Horn reported that progress was being made. Horn wrote in June of the following year that 'hard sinking' was complete, that mining would proceed 'a half the cost we at before', and that 'we have a strong vein but no ore in it yet nor do I expect any yet 'til we come to the Green Mines vein, and then we will stand a good

[434] *D/St/B2/105* miscellaneous accounts for the lead mines and mills.
[435] *D/St/C2/3/75* correspondence between Horn and Stephenson describes the background.

chance'.[436] At this stage in the renewed workings at Birkdale ore production in no way resembled the levels of any year in the 1740s.

It is possible to obtain the ore productivity for mining expenditure at Isabell-mea-hill for the years 1742-45 inclusive, by taking the statistics from the table on page 45 and dividing each year's total expenditure into total ore production. These figures are set out in the Table 6 below. Clearly, on a discreet year basis, productivity for each £1 invested declined from just over one bing in 1742 to just over half a bing in 1745; approximately a fifty per cent fall. Over the four-year period the productivity was three horse one hundred weight and ten pounds i.e. seven stones four pounds short of a bing, for each £1 invested. Unfortunately, no figures for mining

Table 6

Ore productivity for mining expenditure at Isabell-mea-Hill 1742-45

	Total mining Expenditure £ s d	Ore Bings horses	Ore per £1 invested
1742	534 8 7	557 0	1 bing 2st 10lbs
1743	357 14 11½	343 1	3h 4st 9lbs
1744	310 17 11	236 3	3h 0st 10lbs
1745	225 12 11½	129 3	2h 4st 11lbs
Total	1428 14 5	1266 3	

Source: *D/St/B2/105-105*

N.B. The figures for ore production are after washing and dressing.

expenditure are itemised in the lead mine accounts for 1741, only a total of £793 18s

[436] *D/St/C2/3/76* Nathan Horn's reports to Stephenson; and *D/St/C2/3/71* Gibson's mill reports.

10¾d, which would include carriage and smelting costs, and ore production was 514 bing and one horse. By assuming that mining expenditure was the same or thereabouts as in 1742 would not improve the overall level of productivity for capital invested. In the period 1742-45 the average amount of expenditure to produce one bing of dressed lead ore at Isabell-mea-Hill mine was £1 2s 7d.

What of ore productivity per man on the Bowes estate? The imperfect estimates of those employed in lead mining make meaningless any calculation of ore productivity per man. The average ore per man would be of no value. Moreover, productivity was largely determined by geology, which was unpredictable. It is possible, however, to calculate ore per man at particular mines at different times where documents evidence both the numbers of employed miners and ore production. For most mines both types of information are not available; they only exist for Isabell-mea-Hill, Rowton Sike at Lunehead, and Closehouse mines.

The Table 7 below shows lead ore productivity per man, after washing and dressing, and prior to smelting. Once again, most of the available information is for the mine at Isabell-mea-Hill, where productivity was highest in the early 1740s.

Table 7

Productivity -ore per man -for three mines

Mine	Ore (bings, horses, pokes)	Miners	Ore/man (bings, horses, pokes)
Isabell-mea-Hill:			
1744	221b 2h	11	20b 1h 1p
1745	98b 0h	10	9b 3h 1p
1746	80b 1h	16	5b 0 1p
1752-53	90b	7	12b 3h 1p
1754-55	80b	7	11b 1h 1p
Rowton Sike:			
1754-55	50b	4	12b 2h
Closehouse (& Thringarth):			
1751-52	140b 1h	5	28b 0h 1p
1753-54	11b 1h	13	3h 1p

Source:
This table is derived from *D/St/B2112, 120,122 & 137*.

Charles Wensley discovered Rowton Sike; he was granted a twenty-year lease in 1752. Underlying the ore per man figure for 1754-55 is the fact that Wensley himself won thirty of the fifty bing. Closehouse mine showed signs of its subsequent potential for lead ore, but like nearly all of the lead mines at this time it was small scale in every sense.

Lead ore production on the Bowes estate was well recorded during the period 1741 to 1759. The mines recorded as producing ore are Arngill, Black Ark (initially called Cronkley), Closehouse, Cock Lake, Crinkle How, Green Mines, Isabell-mea-Hill (Birkdale), Lunehead including Rowton Sike, Nichol Hopple, and

Standards. Two others, Little Street and Side Lead Mine, where work was carried on in the early 1750's, but for which there are no production figures (the author believes these to be two additional exploratory workings at Lunehead). In addition, Bowes bought in lead ore from Dodd Hill and Pikelaw mines, the former in Weardale and producing good quality ore (ore yield is discussed below). There were five partnership mines during this period; Isabell-mea-Hill, although Bowes' partner, John Dent died in 1742 leaving Bowes to benefit from the most productive mine of them all whilst paying Dent's widow £20 per annum; Black Sike, where in 1747 Bowes had a one third share and his sister and brother-in-law also held the other third share; Lunehead, where there were a number of workable veins, and Bowes had a fifteen-sixteenths share in 1741-42; Rowton Sike, in the Lunehead group, where Charles Wensley was the other partner; Nichol Hopple Yard, where Bowes had a five-eighths share; and Standards, where he had a one half share in the mine. As we have seen above, shares in a mining operation did not preclude Bowes from an agreement for duty ore before any split of cost and profit.

Production statistics for lead ore from all relevant documents are contained in Table I of the appendices, and these exclude estimated or management figures often quoted by agents and stewards in memoranda during visits and sent either to George Bowes himself or to a senior steward, say Richard Stephenson, at Gibside. Table 8 shows that Isabell-mea-Hill, later called Birkdale' was the largest producer of ore during the period 1741-46 and the most consistent in that period and during the period 1752-58.Standards mine was also a consistent producer, but at a much lower level by weight. During the 1740's ore from mines other than Isabell-

Table 8

Total lead Ore Production 1741-1759 by weight in bings, horses, and pokes

	B	h	p	
Arngill	149	0	0	
Black Ark	21	1	1	
Black Sike		2	0	
Closehouse	397	2	0	
Cock Lake		2	2	
Crinkle(d) How				(no records)
Dodd Hill	15	1	0	(bought in ore)
Green Mines	42	2	1	
Isabell-mea- Hill (Birkdale)	2149	3	0	
Little Street (Lunehead)	1	1	1	
Lunehead	340	3	0	
Nichol Hopple				(no records)
Pikelaw	8	1	0	(bought in ore)
Rowton Sike (Lunehead)	70	3	1	
Side (Lunehead)				(no records)
Standards	177	1	0	
TOTAL	3375	1	0	

Source: *Appendix I.*

N.B. The original documents specify production at different Lunehead mines consequently their output has been noted here in the same way.

mea-Hill and Standards was considerably lower. It was during the second half of the 1750's that ore production at Arngill, Black Ark, Closehouse, and Lunehead became more significant, but that from Isabell mea Hill and Standards remained consistent, although the amount of ore from Isabell mea Hill, then Birkdale, was only between a fifth and one-third of the weight produced in the period 1741-44.

Table 8 above clearly indicates the importance of Isabell-meah-Hill lead mine throughout the period; it produced 63.7% of lead ore between 1741 and 1759 based on available records, whilst Closehouse produced 11.8%, Lunehead including Rowton Sike 12.3%, Standards 5.3%, and Arngill 4.4%. Almost 90% of

total ore from Isabella-me-Hill was wrought during the period 1741-46 when it was operated solely by George Bowes. Perhaps its declining potential is why it was noted in 1754 as being worked by Tom Bainbridge, John Bainbridge, and William Tarn.[437] In 1756 Richard Stephenson wrote to George Bowes listing mines that were working, and he noted Isabell mea Hill as "in tack at 25s a bing" i.e. licensed to miners at a rate per bing of ore produced, but not a wage.[438]

Ore production was evidently confined to two periods during the George Bowes mining era; 1741-46, when Isabella-mea-Hill was by far and away the most productive mine; and 1751-59 when Isabell-mea-Hill, Lunehead, Closehouse, Arngill and Standards were the main ore producers. It must be noted, however, that during the latter period Isabella-mea-Hill, Birkdale from about 1757, produced far less than when it was initially worked in the 1740s, and then over a two-year period, 1757-58. The weight of ore from Standards in 1757 was more than twice that produced in 1741-42, whilst Lunehead, including Rowton Sike, became more productive than during the 1740s. Standards, the Lunehead group, Arngill, and Closehouse mines appear to have been those with improving potential, but the lack of records for ore mined, or indeed the lack of production after 1758, forbids any further comment on their development before 1760. Green Mines, with it longer history as a source of lead ore, is not recorded as a productive mine, although thirty five bings were raised in 1751, but only a few in 1757and 1758.

Therefore, of all the mines listed above, only nine are recorded as having produced ore, and then only five continued to show any potential, namely Birkdale, Arngill, Closehouse, Lunehead, and Standards. It was noted above that

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[437] Mentioned in correspondence to Richard Stephenson at Gibside *D/St/C2/3/75 (5)*
[438] *D/St/B2/93* memoranda and reports.

across the period 1729-60 thirty mines/mining areas have been identified on the Bowes estate, yet despite the increase in mining activity only a small proportion were productive. The Bowes estate did manage to coordinate a more sustained level of exploration, discovery, and mining, especially during the 1740s when George Bowes was particularly attentive. There was undoubtedly an organised and concentrated effort to establish lead mining as a developing estate activity, but ore output over almost two decades proves that it was no more than a marginal aspect of the Bowes estate, a mere fraction of the Blackett-Beaumont lead business, and insignificant when compared to the Bowes' coal enterprise. Notwithstanding small-scale ore production and the inevitable lower ranking of lead for the Bowes family by 1760, this enterprise involved should not be underestimated; lead mining on the Bowes estate had become an established feature of the regional economy, though very much in its infancy.

The Bowes lead bearing lands in Upper Teesdale were subject to greater activity compared to the period 1550 to 1722 in terms of exploration, prospecting, deeper mining, expenditure, the numbers of tacks and leases granted to miners and investors seeking an outlet for spare capital, and direct Bowes family involvement. Regionally and nationally, however, the extent of lead ore extraction was negligible. Mines were generally small scale and ore production low by weight and value; this was not a full-scale extractive industry, though George Bowes instigated the beginnings of larger scale lead mining at Isabell-mea-Hill in the 1740s. Most workings were exploratory, but there are examples of attempts at expansion through further discovery and the driving of shafts and levels, such as at Isabell-mea-Hill, and the various mines in the Lunehead group. Nevertheless, this comparatively limited development in lead mining instigated by George Bowes within a small

geographical area built the foundation for larger scale mining from the late eighteenth century and well into the nineteenth century.

There was a discernible level of knowledge and skill in discovering and mining lead on Bowes' land during the mid-eighteenth century, which has implications for a theory of mineral discovery at the heart of metalliferrous mining.[439] Lead was not discovered by chance; Bowes stewards, tenants, and lessee miners demonstrated knowledge and skills which, when applied to the landscape, facilitated the process of exploration for and discovery of lead veins, although it cannot be concluded that their capacities were full proof and predictive.

There is sufficient evidence to suggest that the standard of technology and technique prevalent in the Bowes' mineral pocket was up-to-date and adequate for the scale of extraction. The mines at Isabell-mea-Hill and Lunehead offer the primary examples of the use of blasting to improve the rate of extraction, whilst the problem of ventilation in deeper mining was addressed at Isabell-mea-Hill by the installation of boxed piping. There is no evidence of mechanisation; the scale of mining did not necessitate innovation in the same way as coal mining. Water, muscle, and simple tools assisted by blasting at some mines, were the drivers of lead ore production in this Bowes-owned corner of the northern Pennines south of the River Tees.

Lead mining and related activities were a growing source of employment and income, but mainly as an alternative or additional occupation during autumn and winter. The Bowes' mine at Isabell-mea-Hill was the exception in that it was a managed mining camp for full-time miners during the 1740s when it appears

[439] For further discussion of discovery see M. J. Morrissey & R. Burt, 'A Theory of Mineral Discovery: a Note' in *EcHR,* 2nd series XXIII (1970), pp. 298-313

lead was mined throughout the year. George Bowes' expenditure was focused on this mine, where he built a house or shop to accommodate lead miners.

The output of lead ore on the Bowes estate was comparatively very low and labour productivity, ore per man, was variable, largely determined by geological circumstances and either Bowes or lessee adventurers willingness to invest in shafts and levels to chase the lead veins. Isabell-mea-Hill mine exhibits a decline in labour productivity during the 1740s. Ore productivity per £1 invested also fell at Isabell-mea-Hill during the same period. There is a measure of correlativity between expenditure and output per man in this example, which points to the long-term nature of lead mining and its capital requirements if output was to expand beyond the more easily accessible veins. Evidently, neither George Bowes nor his lessee mining adventurers were committed financially to developing lead mining beyond the margins experienced at Isabell-mea-Hill and Lunehead n the 1740s and 1750s.

By 1760 the Bowes lead landscape was pock marked with small-scale workings at the infant mines of Birkdale, Lunehead, Closehouse, and on Cronkley Fell, which were to experience development in the latter years of the eighteenth century and during the first half of the nineteenth century. George Bowes' flirtation with lead mining was effectively restricted to his investment and personal involvement with the mine at Isabell-mea-Hill during the 1740s, followed in the 1750s by a broader approach to the exploitation of this mineral through the granting of tacks and leases to develop the value of the Bowes family estate. Lead mining undoubtedly became established as a more structured rural industry in Upper Teesdale as a consequence of George Bowes' personal direction, which is examined in greater depth in chapter 8. He was the progenitor of an industry which developed and became more fruitful almost a century after his death, and the first individual

Bowes entrepreneur since the late sixteenth century to be directly involved in the lead business, acting as an agent of change in the agrarian economy of the family's upland estate.

Chapter 6: Mills, Metallurgy, and 'Makings-Out'

The getting of lead ore, actual mining operations, was organised and managed through ownership, including partnership, and leases. Extraction, however, was only the first stage in production, the most expensive in terms of fixed and working capital, and only the first step towards profit. Metallic lead, usually called pig lead, the product of smelting and refining lead ore, was where substantial profits lay, subject to market conditions both locally and in London. George Bowes' strategy for the lead business focused on improving the efficiency of the five stages in the production process that followed lead mining: the washing and dressing of lead ore transporting the lead ore to the mill for smelting; the actual smelting of the washed and dressed ore; transporting the pig lead pieces to another mill for refining when it was believed the silver content was of sufficient value – rare on the Bowes estate; and the transportation to market of refined metallic lead. These linked stages can be dealt with collectively for the purpose of this analysis.

In this chapter the different aspects of smelting will be examined: the crucial role of washing and dressing ore prior to smelting; the smelt mills; the role of the smelters and smelting output - including George Bowes' plans for its development and possible expansion outside the Bowes estate; and the linked operations of carriage of ore to and pig lead from the smelt mills. In doing so, it will be shown that the smelting stage was improved through reorganisation, and the questions as to whether or not technological improvement was evident, and if improved metallurgical productivity was achieved, will be dealt with as far as possible. It is not the purpose of this thesis to re-write the history of lead mining technology and techniques, rather establish the level of technology employed on Bowes lands and to identify any changes introduced in the mid-eighteenth century.

Ore preparation was instrumental in the improvement of smelting. The washing and dressing process was fundamental to the potential yield of metallic lead from ore once the smelter's skill was applied. Its significance has been a source discussion as part of the debate about an industrial revolution in metals.[440] Bowes gave specific instructions to his mines steward about the washing of ore, which included deducting the washers' pay if the work was below standard.[441] The prime question here is whether or not George Bowes was innovative in ore preparation, which is now acknowledged by historians of mining as a key element in the development of lead production.

During the 1740s the washing and dressing of ore was usually done by the miners themselves at the mine. This was the case for both miners employed at the Bowes lead mines and those working under tacks and leases. The majority of the surviving tack notes and leases contain clear statements about the washing and dressing of ore: this is one aspect of the comparative analysis of leases in chapter four above. In the late 1750s, however, the organisation of ore preparation changed when a smelt mill was built closer to the lead mines in Upper Teesdale and washing and dressing became a process carried on at the mill rather than the mines. In the 1740s when the bulk of the ore mined was smelted at Bollihope, George Bowes was already acutely aware of the relationship between carefully prepared ore and the quality of pig lead smelted, and gave clear instructions to this end.[442] There is is some indication of the use of stamps for crushing at Bollihope smelt mill, but no

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[440] Willies, in Day &Tylecote, *Revolution in Metals* ch. 3; Burt, *Ore Preparation Techniques*; and H. Martell, & M.C. Gill, 'Voyage metallurgique en Angleterre' in *Bulletin of the Peak District Mines Historical Society, Vol. 10, No.5*, (1989).

[441] *D/St/B2/91(3)* George Bowes' handwritten memorandum dated at c.1740 by the archivists at DCRO.

[442] *D/St/B2/91* his memorandum about the importance of washing and dressing ore before smelting.

record of washing and dressing by hand there.[443] All lead ore mined on the Bowes estate was smelted at Bowes mills unless stewards were instructed to sell ore, a practice seldom resorted to before 1760

There are detailed smelt mill records for the late 1750s regarding the washing of ore and wastes and the washing and picking of slags, the latter being a source of lead when smelted. Indeed, in 1759 slag smelters were also responsible for washing and picking the slags and were paid according to the amount of lead smelted from the slags.[444] Examination of the smelt mill costs in the pay bills and accounts for the years 1757 to1760 reveals no further evidence of mechanisation of the washing and dressing process. Knockstones and knocking are noted, as are kerns or cams, which are not harbingers of change or development of existing technology.[445]

These circumstances are confirmed to some extent by Gabriel Jars, who visited Britain in the mid-1760s on behalf of the French Government to observe lead mining. Jars noted the wasteful ore washing techniques in the northern Pennines and elsewhere, and that stamps for crushing hard ore were not in use except for the crushing of slag.[446] Stamps were in use at London Lead Company smelt mills from the at least the late 1730s, because stamping of ore into much smaller pieces than could be achieved by hand tools suited the reverberatory furnaces which their mills operated for refining lead and desilverisation.[447]

Washing and dressing of lead ore on the Bowes estate was recognised

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[443] *D/St/B2/103* account of mill charges 1741 mentions cams, which governed the stamping action.

[444] *D/St/B2/126 &127* Jane Rycroft washed ore an wastes; John Baty picked slags and smelted; Thomas Bainbridge washed ore and slags as well as being paid by the day for working as an assistant smelter; and John Langstaff performed the same work as Bainbridge.

[445] *D/St/B2/127* smelt mill accounts covering the period from September 1757 to January 1760.

[446] See G. Jars, *Voyages Metallurgique*, in 3 vols. (Paris and Lyon 1774-1781). See also J. Chevalier, 'La mission de Gabriel Jars dans les mine et les usines Britanniques en 1764', *Transactions of the Newcomen Society*, 26, 1947-8 & 1948-9, pp. 57-68.

[447] Raistrick & Jennings, *History*, pp. 136-137

by George Bowes as a primary skill input in the lead production process which could enhance the skill of the smelter and in that sense act as a catalyst in determining the yield of lead from any given quantity of ore. The most that can be said, however, is that existing techniques were employed at the mines and mills, but that the scale of production and its intermittent nature did not warrant investment that could otherwise have effected changes in metallic lead output.

When the level of lead mining activity increased under the more business-like regime imposed by George Bowes, his objective was to have the ore his agents had harvested, from both leased and owned mines, smelted as quickly as possible. Metallic lead ready for market was the profit-making stage in the production process. The importance of smelting, and more specifically the ownership and location of one or more smelt mills, was the lynchpin in the whole process from mine to market. Mining adventurers, Bowes' lessees, were not smelters and did not own mills, although there is some evidence of smelting on the minefields. George Bowes inherited one lead smelting mill, and ore from his mines and those where he was in partnership needed to be smelted quickly, because he was financially committed to these mines. The growth in lead mining organisation already discussed above necessitated different arrangements for smelting, initially at mills some distance from the sources of extraction, and later the building of another Bowes owned smelt mill. Details of the smelt mills and George Bowes' strategy for horizontal integration, leading to both the creation of another mill on his estate and the search for profit from buying and smelting ore outside his own estate and the northeast, demonstrate the changes aspired to in managing the estate during the mid-eighteenth century.

During the 1740s, however, there were at least two mills smelting and refining lead ore from the Teesdale mines, namely Bollihope and Acton. Acton

appears to have been used briefly and specifically for refining lead and extracting silver when it occurred in the lead veins. The only record found referring to silver is a pay bill for Isabell-mea-Hill for the period 1744-46 in which itemised payments for winning silver appear next to miners' names.[448] At this point it should be stated that, unlike the Blackett-Beaumnonts for whom silver was always a valuable product derived from lead output, there is no evidence that the Bowes lead business benefited from this precious by-product. The Blackett-Beaumonts made a profit from silver alone of £6,972 between 1744 and 1760.[449]

Between 1741 to 1746 ore from Isabell-mea-Hill mine, and duty ore only from the Arngill, Closehouse, Lunehead, and Standards mines was taken to Bollihope Mill, also known locally as Bolliop or Boylup Mill, for smelting.[450] Bollihope mill was the primary smelt mill for Bowes estate ore during throughout the 1740s, its activities recorded in various memoranda comparing it with possible smelt mills in other locations, and accounts of deliveries of ore and pay bills. [451] This mill continued to be used until at least 1749, smelting ore from the Bowes' mines. James Sanderson was in all probability the leading smelter assisted by another family member, Lane Sanderson.[452] By 1751 Bollihope Mill was owned by a Mr. Bacon, and

George Bowes instructed his agents, Nathan Horn and Francis O'Neale to enquire about the cost of using it.[453]

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[448] *D/St/B2/120* pay bill for Isabell-mea-Hill mine.

[449] Hughes, 'Lead, Land and Coal' (unpublished PhD Thesis) pp.91-96 and Appendix Table 13.

[450] *D/St/B2/105* 'Ore delivered at Boylup mill' contains figures for each year from 1741 to 1745.

[451] *D/St/B2/135*, 13 papers various memoranda, some handwritten by George Bowes, assessing the possibility of building mills to reduce costs and avoid using Boylup Mill. Archivists have dated papers in the mid-eighteenth century. *D/St/B2/154-157* inclusive are accounts covering the period 1741-45, and *D/St/B2/125* are pay bills.

[452] *D/St/C1/3/59* James Sanderson's report to George Bowes dated 1st August 1743, 'this is the second account from the Mill'. Sanderson is mentioned s the chief smelter in *B/St/B2/105*. Also *D/St/B2/103 (7)* James Sanderson's handwritten account for smelting ore from various mines at Boylup Mill. Smelt mill pay bill *D/St/B2/103* 1741 and Francis O'Neales account *D/St/E3/5/21* 1742 name the Sandersons and another smelter in 1741, Thomas Moses,

During the 1740s James Sanderson was the organiser of ore and pig lead to and from this mill.[454] Pig lead produced by smelting ore at Bollihope Mill was carried by pack horses to Wolsingham where it was held over for transhipment to Tanfield or Shield Row.[455] A memorandum of 1742/3 describes the carriage of ore to Bollihope then pig lead to Wolsingham.[456] The 1742 account of Francis O'Neale, a Bowes agent, details the movement of ore from certain mines to Bollihope and the movement of pig lead to Wolsingham.[457] Wolsingham was still the staging point in lead carriage to the staithes on the Tyne in the late 1750's.[458] Wolsingham was not a smelting or refining location for Bowes lead, though it was a terminus for lead carriage.[459] In 1746 another mill was also employed to smelt Bowes ore from the Arngill, Lunehead, and Standards mines which, together with duty ore, were delivered to Acton Mill.[460] This smelt mill was built by the London Lead Company in 1710 to handle ore from its mines in the upper Derwent Valley; it smelted ores and slags, and refined lead and extracted silver.[461]

Bollihope Mill must have operated an ore or blast hearth, which could use peat as the main fuel, cheaper than coal, and readily and abundantly available on the Upper Teesdale moors. The smelting process occurred at a lower temperature, it was quick to get underway, used bellows, but generally needed waterpower and

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453 *D/St/B2/2*, George Bowes handwritten memorandum of 16th August 1751 from Bowes to agents

454 Bowes' agent Mr. Leaton wrote the 'Weardale Carriage' account for Sanderson, dated 16th November 1741.

455 *B/St/B2/135 (12 &13)* These two papers in George Bowes' handwriting mention Wolsingham.

456 *B/St/B2/135 (7)* A memorandum concerning costs involved in smelting.

457 *B/St/E3/5/2*, Francis O'Neales's account book for 1742.

458 *D/St/C2/3/76* Nathan Horn's report to Richard Stephenson regarding pig lead delivered to Wolsingham of 16th November 1758, and *D/St/B2/150* accounts of lead smelted 1756-1764.

459 Lead smelting in Wolsingham was evidently an established industrial activity from no later than the early fifteenth century, drawing in ore from both Weardale and Teesdale, for the production of pig lead and silver; Raistrick & Jennings, *History*, pp.53-54.

460 *D/St/B2/81*, Nathan Horns 1746 account of ore delivered to Acton Mill.

461 Raistrick & Jennings, *History*, p.121 and p.136

did not facilitate the refining of lead or the extraction of silver. Acton Mill, owned by the London Lead Company, very probably operated a reverberatory furnace.[462] This Company had already in 1733 introduced a reverberatory furnace at its smelt mill in Swaledale to service its lead mines there.[463] The reverberatory furnace was a more sophisticated piece of smelt mill equipment requiring substantial capital investment, but it allowed smelting of better quality ores, refining, and the extraction of silver. The Bowes mines must have briefly produced ores of a certain quality, which necessitated the skills and infrastructure available at Acton in order to obtain a more desirable metallic lead product, and quantities of silver. Perhaps this can be taken as a pointer to Acton as the most suitable for silver in the 1740's, or maybe it was for hire because the London Lead Co. mines occasionally did not deliver sufficient ore to keep Acton Mill at capacity, though this seems unlikely.

During the early 1750s Egglestone Mill was in operation, probably owned by Anthony Appleby, but it is not clear whether or not George Bowes employed the Egglestone Mill in the same way as Bollihope and Acton, [464] though he sold lead ore to Appleby for smelting. Egglestone was, however, geographically closer to estate mines. For the period 1750 to 1757 Bowes ownership of Bollihope mill is in question, but it has not been possible identify Andrew Appleby's mill at Eggleston as a smelt mill used by George Bowes in the mid-1750s before Wemmergill became the hub with the Upper Teesdale mines its catchment area, but it is a possibility because the ore produced was either held as stock or needed to be smelted somewhere. There is an indication that Samuel Bacon owned Bollihope in the early 1750s, and on one occasion George Bowes instructed an agent to enquire as to

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462 *Ibid.* p.121.
463 *Ibid*. p. 124.
464 *D/St/B2/149* Accounts of lead ore bought from George Bowes by Anthony Appleby for Egglestone Mill between 25th December 1752 and 6th January 1755.

the cost of using it, which is detailed below in the discussion of his personal role.

George Bowes understood the importance of smelting, the value the smelter's skill added to the end product, yet he was also acutely aware of the costs involved in not possessing a smelt mill which was sited in near proximity to his mines. His objective was to own and operate a smelt mill on or very near the orefield, thereby minimising the costs of carriage of both ore and pig lead over difficult terrain. After lengthy consideration during the 1740s and early 1750's, Bowes decided to invest in the building of a smelt mill at Wemmergill in Lunedale, which was closer to the lead mines. Construction must have begun in 1756, but not completed until the following year. John Gibson, the Wemmergill smelt mill manager, wrote to Thomas Colpitts II, a senior steward to George Bowes, on 11th October 1757 to inform him that Nathan Horn, mines steward, had visited the new mill to discuss the building of the wheelhouse.[465] This would seem to indicate that the mill was not in use at that time. It has been suggested that Wemmergill Smelt Mill was built and completed in 1756, but the records show that building only began in 1756 and smelting operations commenced in late 1757.[466] Wemmergill smelt mill was fully operational in 1758, but whether it was always fully employed is a different matter. [467] There are numerous documents indicating the level of activity at this mill in the late 1750's; Gibson's reports,[468]and Horn's reports [469] reveal that in 1757 and 1758 Wemmergill was receiving and smelting ore at an acceptable level, but that lower production in 1759 was cause for George Bowes to question his lead business. Smelt

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[465] *D/St/C2/1/21*

[466] *D/St/B2/127,* a smelt mill account containing an item for 1s. 1d. paid to John Briggs for nails 'omitted by Nathan Horn in 1756 when the Mill was building'. R.A. Fairbairn, *The Mines of Upper Teesdale, British Mining no.77* (Northern Mine Research Society 2005) suggests the mill was completed in 1756.

[467] *D/St/C2/3/77 (19)* Gibson's letter to Stephenson dated 24th September 1758.

[468] *D/St/C2/3/77 (5,7,8, & 10).*

[469] *D/St/C2/3/76 (8,10, & 16).*

mill production is examined later in this chapter.

George Bowes' instruction regarding carriage and costs was unambiguous; he wanted to get smelted lead from the mill 'as fast as it is smelted'.[470] However, of the different variable costs which preoccupied Bowes' thinking on lead production, carriage costs were the main source of anxiety. For example, in the early 1740's he instructed Thomas Colpitts to look into reducing carriage costs by using a different carrier.[471]

During the 1740's Bowes instigated research into the possibility of building other smelt mills, which involved comparative analysis of carriage costs and possible locations for a new mill.[472] George Bowes was seduced by the discovery of lead at Isabell-mea-Hill in 1741, and during the 1740's this was one of the mines which sustained his enthusiasm for the potential of the lead business. Perhaps it is quite reasonable, therefore, to expect that at this stage Bowes should have been planning, researching, and analysing his options for cost reduction and investing in his own mill. There is no clear indication of the order in which they were written and presented; suffice it to say these papers were all produced for the personal attention of George Bowes, who subsequently wrote memoranda clarifying and comparing the assessments written by individuals he had instructed to supply him with plans and costs for the building of a smelt mill.[473]

'Elliot's Calculations for building a mill at Staindrop', in George Bowes hand, assessed that the materials cost would be £1-4s-8d to produce a fother of

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[470] *D/St/B2/91 (2)*

[471] *D/St/B2/91(3)* Bowes' instruction to Colpitts to contact the Sandersons at Bollihope Mill.

[472] *D/St/B2/135* (13 papers) contains memoranda together with computations of costs for the building of lead mills in various places. Two papers are dated 1742, the rest are undated.

[473] *D/St/B2/135 (1), (2),* the reverse side of *(5), (6),* and *(12-13)* are all in George Bowes' handwriting.

lead at Staindrop, but only £1-2s-0d if smelting was done in 'a mill at ye Mine'.[474] The main difference was the costs of carrying 20 pieces of lead to Staindrop; nevertheless it was still cheaper to build near the source of extraction, probably Isabell-mea-Hill mine. Another memorandum entitled 'A Mill at Holwick', again in Bowes' hand, also shows that it would have been cheaper to smelt here rather than Staindrop, by 1s-8d, and that once again the difference in cost was the carriage of lead to Staindrop.[475]

The idea of building a smelt mill local to the mines continued in another memorandum 'A Computation maid for a Lead Mill at ye Mine', comparing smelting done at 'ye mine' at £13-5s-1d with that at Mickleton at £13-5s-10d.[476] These were calculations for the production of a fother of pig lead including the costs of carriage for ore and pig lead, the pig lead going to Stockton. George Bowes extended this comparison of location and related costs in his handwritten memorandum 'Elliot's Computation about building a Smelt Mill', in this case at Spurls Wood where the cost of making a fother of lead and carrying it to Newcastle via Wolsingham was assessed at £13-7s-2d.[477] A note was made on the reverse side of this document comparing the carriage cost of 15s 8d for pig lead to Dufton, in Westmoreland, against 12s 0d to Newcastle. Also on the reverse side of the memorandum regarding a mill at Mickleton, there are scribblings in Bowes' handwriting comparing the differences in specific variable costs – materials, carriage, and the cost of smelting lead from slags- at Spurls Wood and a mill at 'ye mine'. He estimated that it was cheaper to smelt lead from slags at Spurls Wood than build a mill near the mine, noting that for every 400 bing of ore smelted at the mine £20

[474] *D/St/B2/135 (1).*
[475] *D/St/B2/135 (2).*
[476] *D/St/B2/135 (5).*
[477] *D/St/B2/135, (6).*

would be lost in smelting the slags.[478]

'Jas. Pattisons computation for erecting a Lead Mill' of 1742 does not indicate a location, but states an exact cost of £130, a not insubstantial capital outlay of its day.[479] It was a significantly higher estimate than those produced by Elliot if it did relate to the idea of a smelt mill near the ore fields. On the other hand, it may be an estimate for a mill near Keswick, which was of serious interest to George Bowes.

A memorandum of 1743 entitled 'The Difference shown between Smelting at Boylup and building a New Mill at Issabell-mea-hill', there is no mention of building costs, instead it concentrates on the cost of smelting at the two locations, and is based upon the 600 bing of ore mined at Isabell-mea-hill in 1742. It states that the cost of smelting at Boylup was £167-3s-4d in 1742, whereas if a mill was built at Isabell-mea-hill the cost would be only £107-15s-0d, a saving of £59 8s 4d for every 600 bing of ore smelted. Evidently, the main cost difference in this smelting process was the carriage of ore to Boylup or to a mill adjacent to the mine, the latter destination saving £120. Pig lead carriage from a site near Isabell mea Hill to Wolsingham would have cost £87 15s compared to £22 3s from Bollihope, but the reduction in ore carriage costs tipped the scales in favour of a mill location in Upper Teesdale.[480]

There are several estimates for the costs involved a smelt mill project in Thornthwaite, near Keswick. 'The Real Charge of building a Lead Mill at Keswick in Cumberland with One Hearth' shows a cost of £99-5s-7¼ d.[481] A further version of

this assessment dated 23rd April 1742, showing identical costs and naming the location as 'Thornthwaite nr. Keswick'.[482] Yet another, entitled ' 'A computation of

[478] *D/St/B2/135, (5).*
[479] *D/St/B2/135, (8).*
[480] *D/St/B2/135, (7).*
[481] *D/St/B2/135, (3).*

building a Lead Mill with one Hearth', which does not state the actual location, was written by Messrs. Boag & Walton, estimated the cost at £170-4s-0d.[483] Messrs. Boag & Walton presented Bowes with a fuller version of their initial costs, which included a plan of the smelt mill incorporating an extension to double its size.[484] On the back page of this document is Mr. Boag's figure of £170-4s, which includes bellows from London at £30, which must also be for a mill near Keswick.

It is noteworthy that Boag & Walton were Nicholas Walton Snr. and Henry Boag, who from 1735 were the two Receivers for the Greenwich Hospital Estate, which had lead interests on Alston Moor and at Thornthwaite near Keswick. They held influential management positions in that they had the authority to grant leases and also acted as agents for Sir Henry Liddell.[485] It may have been that George Bowes considered a lead mining lease or permission to build and operate a smelt mill.

Lastly, in 'A computation of the Expence of erecting a Smelting House, Bellowshouse, Wheelhouse, Peathouse, Coalhouse, Bingstead, and Office', the wheel, the bellows, and timber made up almost half of the total cost of £120.[486] There is no indication of this estimate being connected to a smelt mill near Keswick, and because there is a note about iron being at Streatlam Castle there is reasonable probability this document relates to the mill at Wemmergill. It would appear to be on the same scale as Pattison's estimate for building at £120, but there again those estimates which clarify the Lakeland location show a figure of £99-15s-7¼ d. Perhaps the documents are a variation on a theme, subject to specification and the surveyor's judgment as to what would result in the most useful mill for George Bowes. Again,

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482 *D/St/B2/135, (10).*
483 *D/St/B2/153, (4).*
484 *D/St/B2/135, (11).*
485 Hughes, 'Lead, Land and Coal' (unpublished PhD thesis) pp. 18-19.
486 *D/St/B2/135 (9).*

the Boag & Walton plans and estimate of costs could relate to an existing mill, which needed refurbishing with a view to expanding the mill's capacity.

The idea of Bowes refurbishing an existing mill or building a new mill near Keswick may not have been as wildly speculative as it may appear. In 1474 Edward IV appointed a fifteen-man commission to follow up George Willarby's report of three mines producing lead ore with a high silver content, one near Keswick, the other two were Blanchland, and Fletcheroos on Alston Moor.[487] There were commercially viable lead deposits near Keswick, Helvellyn, and Caldbeck Fells in the Lake District.[488] The economic and social history of the Lake counties only confrims the incidence of copper mining in the eighteenth and early nineteenth centuries; lead is only mentioned with reference to production in the Alston area of Cumberland.[489]

George Bowes instigated the research into the viability of creating one or more smelt mills. 'Some Memds. relating to the building of a Smelt Mill' provide further evidence of his personal, direct involvement in assessing the most lucrative market - Newcastle or Stockton – and the key variable factors in the development of the infrastructure for ensuring the most efficient, and ultimately profitable, process of getting metallic lead to market. Bowes knew that control of costs at the various stages would determine the profit achieved in his chosen market: smelting costs were paid by the fother, and these could be mitigated by better washing and dressing of ore and the skill of the smelters; fuel costs, peat or coal, by the horse load; transportation costs were based upon the weights of ore and smelted lead carried by pack-horse; travelling distances and terrain governed the carriage speed of ore and smelted lead; and then

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[487] Raistrick & Jennings, *History,* p. 48. The silver content of this lead ore is also referred to in Burt, *British Lead,* p. 21.

[488] *Ibid.* p. 9 &13.

[489] C.M.L. Bouch & G.P. Jones, *The Lake Counties 1500-1830: A Social and Economic History* (Manchester 1961).

there was the potential cost of using an agent in marketing metallic lead, subject to the particular market. So, in the early 1740's George Bowes was performing a comparative cost analysis of whether to market his product in Newcastle or Stockton, which in turn would enable him to reach a decision as to where he should invest in the building of one or more smelt mills.

George Bowes understood that the knowledge and skill of the smelter was a prerequisite of producing good quality metallic lead. In one note he refers to 'Thomas Moses late a Smelter to Mr Vane' who had offered Bowes his services and told him that 'there is a great deal of art in building hearths ', as well as demonstrating his knowledge of the costs involved. Bowes noted that Moses built the hearths for Mr Vane.[490] Clearly, Bowes was considering the possible value of this smelter to his proposals for building a mill. In June 1741he visited Bollihope Mill to assess the cost of smelting lead ore, where he negotiated with the smelters the smelting of twenty bing of ore before he would agree their rate of pay. He knew the quality of the pig lead smelted was heavily dependent on the smelters' skill and, of, course, was seeking to control future costs by discovering the amount of pig lead they could produce from a given amount of ore.[491] Bowes was also aware that ore which had been carefully washed and dressed enhanced smelting and the quality of the metallic lead produced thereby. Indeed, the better preparation and dressing of the ore was a prerequisite of smelting in a reverberatory furnace.[492]

The mid-eighteenth century technology for the extraction of lead ore by miners on the Bowes estate was current but in no way in advance of any other

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[490] *D/St/B2/135 (12 and 1).*
[491] *D/St/C1/3/60 (1)* Thomas Colpitts I memorandum to George Bowes of 18th June 1743 referring to the visit.
[492] Raistrick & Jennings, *H istory*, p.124.

lead mining district. Essentially it came down to basic tools and muscle power assisted by blasting with gunpowder. There is no indication at this stage of either George Bowes or any incoming lessee adventurer introducing improved technology to enhance efficiency of extraction below ground. Did George Bowes, who monopolised the smelting process on his estate, introduce new methods or technology into smelting?

The bulk of the lead ore from the Upper Teesdale estate was transported to the Bollihope smelt mill during the 1740s. The mill was a water-powered wheel driven mill containing an ore hearth and a slag hearth. Accounts of materials and equipment used at Bollihope confirm the probability that this smelt mill was based on an ore hearth rather than a reverberatory furnace.[493] There were two smelters, Thomas Moses and James Sanderson from August to November 1741, and, apart from lead ore, the materials mentioned are peat, coals, and lime. The types of equipment mentioned are the wheel, bellows, and pigg pan. These materials and equipment point to ore hearth smelting at Bollihope, which did not preclude desilverisation if the ore was of silver-bearing quality.[494]

The smelt mill at Wemmergill was probably ore hearth and slag hearth, if for no other reason than the ridiculous expenditure that would have been necessary to transport large amounts of coal there to fuel a reverberatory furnace. The terrain and complete absence of a road infrastructure made it impossible in any event. The smelt mill records for Wemmergill are somewhat better than those for Bollihope.[495] Again peat by cart, lime, and coals are stated as materials; the coals were carried in from Craksescarr on the South Durham coalfield. Also stated in the

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[493] *D/St/B2/103* expenditure account for Boylup smelt mill.
[494] See Willies in Day & Tylecote, *Revolution in Metals,* p. 86.
[495] *D/St/B2/126* mill charges, and *D/St/B2/127* smelt mill pay bill.

documents are hearth building, knocking slags, and slag smelting. Again, this detailed information clearly evidences the existence of ore and slag hearths.

There are but two indicators of how John Gibson was considering improving pig lead output. In late1758 he wrote to Richard Stephenson at Gibside suggesting that 'All the slags might be worked in winter', his primary reason being that slag smelting was a slower process, which if done in the summer would have severely restricted the whole process and leaving carriers temporarily unemployed when they could have been carrying pig lead to Wolsingham.[496] In the same report to his senior steward, Gibson wrote 'Some Improvement might be made in Manufacturing the Ore; when I mentioned it, the Smelter told me that Mr. Horn said I had nothing to do with it'.[497] Gibson appears to have been considering improving the smelting process, but there is no evidence of how or to what extent. George Bowes was fully aware of the nature of smelting and the key to successful smelting within the confines of the existing technology– the smelter's skill. George Bowes did not bring about a change in technology or smelting methods, rather his main concern was cost reduction, which he achieved by transplanting the smelting process at Wemmergill, thereby reducing the cost of ore carriage. Peat was readily available as fuel for the ore hearth, as it had been at Bollihope, and this, combined with the scale and intermittent nature of smelting ore from the Bowes estate, meant that at this stage in the development of lead production in Teesdale technological change was unnecessary and economically unviable.

The smelt mills receiving deliveries of ore from the mines have been discussed above, and it is clear that George Bowes strove to establish his own mill

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[496] *D/St/C2/3/77* correspondence between Gibson and Stephenson October 10th 1758.
[497] *Ibid.*

as mining developed at Isabell-mea-Hill and beyond in Upper Teesdale. During the 1740's and early 1750's ore from his estate was smelted at Bollihope, with refining for silver only identified Acton if a reverberatory finance was essential, but quite possible in the ore hearth at Bollihope. Bowes mill at Wemmergill began smelting ore in 1757. There was no smelting activity at any mill for the period 1750-56, because evidently ore production was insufficient, a result of stockpiling and the consequences of war.

Table 9

Lead smelted and delivered to the staith at Newcastle upon Tyne during the period1741-1760

	Pieces smelted	**Mill**	**Pieces delivered to Wolsingham**	**Pieces delivered To Shield Row**
1741	1666	Bollihope	960	960
1742	1409	Bollihope	1802	1802
1743	1663	Bollihope	1724	1724
1744	355	Bollihope	605	605
1745	1078	Bollihope	1044	1034
1746	249	Bollihope	248	258
1747	559	Bollihope	375	375
1748	275	Bollihope	360	360
1749	56	Bollihope	56	56
1750	There are no estate records for 1750-56			
1751				
1752				
1753				
1754				
1755				
1756				**To Tanfield Moor**
1757	700	Wemmergill	220	920
1758	1927	Wemmergill	1422	1420
1759	13	Wemmergill	282	226
1760	112	Wemmergill		

Source:
Created from the figures for smelted lead pieces extracted from *D/St/B2/105* (for the1740s), *D/St/B2/150 & 157* (for 1757), *D/St/C2/3/77* (for 1758), and *D/St/C3/77* (10 &12) (for 1759). The figure for 1760 is from *D/St/B2/150*, an account of lead smelted.

There are accounts of smelted pig lead for all but one year of the 1740s and for the years 1757-1760. Table 9 above lists the amounts of pig lead smelted and delivered to the staith at Dunston on the River Tyne during the period from 1741 to 1759. The difference between the amounts of pig lead smelted and the amount delivered is accounted for by the lead lying locally. Trade in smelted lead, both locally and by ship down the east coast, is discussed later.

Lead ore from the Bowes estate during the 1740's was smelted at Bollihope Mill and produced 7310 pieces(or pigs), of which 7174 pieces, or 98.14%, were delivered to Wolsingham and then transhipped by packhorse to Shield Row, from where the pig lead was taken more cheaply by waggonway to the staith. One variation occurred in 1746 when 36 bing from Lunehead, 37 from Standards, and 23 from Arngill as delivered directly to Acton Mill, not Bollihope, for smelting[498]. In the Lead Account ledger for the 1740's there is no ore recorded as delivered to Bollihope in 1746, but there is a record of pig lead smelted at Bollihope in 1746, but not at Acton.[499] In the latter years of the 1750's ore smelted at Wemmergill converted into 2939 pieces, of which 2630 or 93.03% reached Wolsingham before it was carried again to Tanfield Colliery to join the waggonway en route to the Tyne.

The statistical evidence for amounts of pig lead smelted highlights low output for most of the 1750's. George Bowes own efforts were subdued at this stage, and ore output was mainly a consequence of lessee activity. Ore must have been smelted, but not at a Bowes owned mill.[500] In the late1750s there was a resurgence in activity and in 1758, 915 pieces of lead were carried from Tanfield Moor to the Staith,

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[498] These amounts of ore mined at the three stated mines are included in Table I of the appendices, and included in the ore production summary in Table 8, Chapter 5 above.

[499] *D/St/B2/105*.

[500] Ore production figures in Table I of the appendices show mining activity in several mines.

and a further 258 in 1760, but none in 1759.

George Bowes was often preoccupied with the yield of smelted metallic lead from lead ore, an idea which permeated the estate management system. The amount of smelted lead that a bing of ore produced relied upon three factors: the quality of the ore after washing and dressing; the skill of the smelter; and the basis of the process - smelting in an ore hearth or in a reverberatory furnace or cupola. The desilverising or refining of metallic lead could be done in either the reverberatory furnace or the ore hearth.

In 1741 one of Bowes' agents, Thomas Colpitts I produced a summary analysis of 'Oar Makings Out', which included the mines at Isabell-mea-Hill, Lunehead, Standards, Arngill, and bought in ore from Dodd Hill.[501] His reckonings are below in Table 10, , and he commented that 'All these very bad'.[502] Unusually, Colpitts' final figures were in decimal form, rather than bings, horses and pokes.

Table 10

'Makings Out' – the yield from lead ore in 1741

Source of ore	Bings		Fothers	Corrected Bings
Isabell –Meah-Hill	4, 8	to	1	4, 83
Lunehead	6, 5	to	1	6, 5
Standards	7, 83	to	1	7, 83
Arngill	6	to	1	6, 93
Dodd Hill	5	to	1	4, 77

[501] *D/St/B2/154 (1)* 'Oar Makings Out for 1741'.
[502] Quoted from *D/St/B2/154 (1).*

Source:
D/St/B2/154 'Oar Makings Out for 1741'.

In 1741 514 ¼ bings of ore were smelted at Bollihope Mill producing 1666 pieces of smelted lead, or 104 fothers and 2 pieces (where 16 pieces is one fother). The average bings needed to smelt a fother of lead was, according to Colpitts, 4.83, but the corrected amount is 4.94. Therefore, the corrected figures show to produce one fother of pig lead required slightly more ore than Colpitt's reckoned, that yield was very slightly more disappointing than he believed., but that in terms of quality Isabell mea Hill ore and the bought in ore from Dodd Hill were distinctly better than other sources in that year.

Another of George Bowes' agents, Mr O'Neale, reported in 1742, his assessment of ore yield in 1741.[503] His figures for the amount of ore from the same sources to produce one fother of pig lead are identical to those of Colpitts, with the exception of 0.03 less for Standards mine. A memorandum written by George Bowes in 1742 contains the comment 'If 4 Bing makes a Newc foder or 21Ct… 32oz of Oar produces 21 oz of Lead', a more optimistic assessment of yield than those provided by the field agents.[504] He also wrote 3B 3H 4St 12 lbs, suggesting a calculation that 3 bings 3 horses 4 stones and 12 pounds of ore could produce a fother of pig lead, which would have been a huge improvement in yield.

George Bowes gave serious consideration to O'Neal's report and the matter of yield and wrote his thoughts on the memorandum. He noted the relative quality of Dodd Hill ore and that O'Neal had omitted to mention its delivery to Wolsingham and queried 'why this Oar is not refined (and) if any was sent to ye

[503] *D/St/B2/155 (18)* entitled 'Mr O'Neals Account of ye Lead Mills 1742'. He includes a breakdown of costs by source for ore, carriage, and smelting involved.
[504] *D/St/B2/135(6).*

Mills'.[505] This would indicate his expectation of silver content. He also wrote ' a Fother of Lead yields 10 stone out of ye slags unpicked. …(but)…. picked only 5 stone'.[506] Consequently, he wrote a reminder about preventing workers from picking 'to give orders about picking ye lead out of ye slags.[507]

Again, Bowes demonstrated his attention to the details of costs when he wrote beneath O'Neal's figure for yield at Isabell-mea-Hill 'Elliot says on a calculation at Raby it was found that about 8s p(er) Fother might be saved by building a Mill at ye Mine rather than at their present Mill'.[508] Extending his thoughts along somewhat more pessimistic lines, and to avoid altogether the problem of yield, in 1742 Bowes wrote 'if not to my Advantage to lay in my Lead Mynes. To consider if it is not proper carry on the Myne and lay off the oar after it's washed in the Mill's shop'.[509] Even at such an early stage in the development of his lead business, George Bowes gave serious consideration to the ramifications of continued involvement in the whole process of lead production.

After the Bowes' smelt mill at Wemmergill commenced operation, the manager, John Gibson, calculated a more precise figure for the yield of smelted lead from ore. Gibson's memorandum of 24th June 1758 to Richard Stephenson at Gibside contained the following summary of his calculation: 'The whole quantity of ore received is 349B: 2 5/6th h, which is smelted into 87F:14C: 2qr: 7lb Lead. Hence 4B, 2h, 0 stone, 2lb of ore has produced a Fother of Lead at the first Fire. - I think there will be somewhat above 4½ fother of slag Lead. - Suppose 4F: 12C: 1qr: 2lb which added will make 92F: 6C, then 4Bing: 1 horse: 1 Stone: 11 pounds will make a Fother at first and second Fires, which considering the ore is good produce'.[510] This

[505] Quoted from *D/St/B2/155 (18*) where it is in Bowes' handwriting.
[506] Quoted from *D/St/B2/155 (18).*
[507] Quoted from *D/St/B2/155 (18).*
[508] Quoted from *D/St/B2/155 (18).*
[509] Quoted from *D/St/B2/155 (18).*

suggests that the yield per bing of ore had improved at Wemmergill in the late 1750s compared to that of the early 1740s.

The smelt mill at Wemmergill was planned and built in close proximity to the Bowes mines in order to reduce carriage costs, which in turn would increase profits at market. An improvement in the yield of lead from ore would further enhance the effect of George Bowes having his own mill. Gibson estimated that the new mill was productive, although hinting perhaps at the relatively lesser quality of some ore. During 1758 Richard Stephenson performed an historical comparative analysis entitled 'Computation of the great difference of Lead from the same quantity of ore smelted at Boylup Mill and that quantity at our own Mill'.[511]

Stephenson's case was that in 1743 343 bing of ore produced 72 fothers 6cwt 3qr 0lbs, whereas in 1757 and 1758 the same quantity of ore produced 77 fothers 5cwt 0qr 2lbs - a 4 fother 6cwt 1qr 2lbs increase. In other words a 7.25% increase in yield from the same amount of ore.[512] Also contained in the same document Stephenson calculated the change in yield in stones of lead produced from one bing of ore. In 1743 the yield was 33 1/3rd stones of lead, but in 1757 and 1758 it was 35 ¾ stones of lead. This improvement equates to a 7.26% increase in yield. It must be concluded that ore preparation and smelting had been managed to improve, and that perhaps sometimes ore was of better quality.

The linked stages in the smelting chain – washing and dressing of ore, carriage of ore to smelt mill, smelting, and carriage of pig lead to market - were

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[510] *D/St/C2/3/76* Gibson to Stephenson of 24th June 1758.
[511] *D/St/B2/157* in Stephenson's handwriting.
[512] The author believes that there is a minor error of 3 ½ horses of ore missing in Stephenson's addition of amounts of ore from the mines he lists for 1757, but this would not make any significant change to his figures for yields and improvement in yield.

micro-managed by the Bowes estate's specialist stewards and George Bowes himself. Problems in ore preparation were addressed, although the extent of improvement is difficult to assess. Before 1757 lessees did their own washing and dressing at the mines, and there is evidence of labour specialisation in this process at Isabell-mea-Hill in the 1740s, and later at Wemmergill smelt mill in the late 1750s, and stamps for reducing the size of veinstuff rather than doing it by hand. Generally, Bowes' management attempted to improve ore preparation to concentrate the ore so that it made up to sixty or seventy percent of the raw material delivered to the smelter.[513] Like many mineral owners he was probably more accustomed to bouse or veinstuff with lower lead content.[514] Overall, ore preparation was a manual process during this period, though manual technique was improving and labour saving machinery beginning to appear, which in turn would have meant a cost saving and better quality lead for market.

For most of the period 1739 to 1760 ore mined and prepared on Bowes land was smelted at the Bowes' mills – Bollihope in the 1740s and Wemmergill from 1757. The Bowes estate management, including George Bowes, demonstrated a detailed understanding of the technology and techniques required for smelting lead in the small-scale industrial environment of Upper Teesdale estate. The smelting process was better managed under John Gibson at Wemmergill; the yield from lead and general productivity received more serious attention, though the significance of 'makings-out' were not overlooked by Bowes and his stewards in the 1740s. At Wemmergill there was more professional oversight and evidence of Gibson's ability to alter the variables the smelter had to contend with in producing pig lead, including

[513] The percentage of concentrate is taken from Burt, *Ore Preparation*, p. 6.
[514] W. Forster, *A Treatise on a Section of the Strata from Newcastle -on –Tyne to Cross Fell* (Newcastle 1883) p.173.

the smelting of slags[515]. In the late 1750s it seems there was a managed improvement in metallurgy; the Bowes mill was producing more metallic lead from any give amount of ore, which also has implications for the standard ore preparation which at that stage was largely done at the mill. Again, there are no records of silver being refined from lead, yet silver content in ore in North Pennines is generally viewed as relatively high, which often made viable lead mines that would otherwise have been uneconomical.[516]

Smelting and the carriage of ore to and lead from the smelt mills became better organised under George Bowes. Carriage costs were cut, most importantly those for ore, and the management of carriage centred on Wemmergill from 1757 rather than the apparent dual management by smelters and stewards in the 1740s. The following chapter considers the movement of lead to market, supply and demand, sales and purchases, and the factors affecting the market mechanism.

[515] See Willies in Day & Tylecote, *Revolution in Metals,* p.92
[516] *Ibid* p.86

Chapter 7: Markets, Movements, Merchants, and Money 1740-60

George Bowes' grasp of the lead business and his awareness of its significance as a valuable commodity in regional, national, and overseas markets during the mid-eighteenth century becomes even clearer when the trade in lead is examined in greater depth. He and his stewards had to overcome not only problems associated with the finding and production of lead, but also those related to its movement to market and operation of the market. This chapter examines a number of important features of the lead business: Bowes interaction with the three identifiable markets; the regional market focused on Newcastle; the national market focused on London; and the overseas markets reached through both Newcastle and London; the ports and their roles in the lead trade; the regional trade in ore and pig lead; lead sales, price movements, and determinants of fluctuations, the characteristics of the lead market mechanism; the movement of lead to market: and the Bowes response to market fluctuations during two decades overshadowed by two wars.

The recorded lead production on the Bowes estate during the period 1740-60 reflects an apparent surge in demand ending 1749, which was later repeated on a lesser scale in the period 1757-60. The relative absence of extraction, smelting, and pig lead sales during the intervening years from 1750 to 1757 do not automatically imply that George Bowes alone, or as a member of a cartel, stocked lead enabling him to control supply and price, but it could distract us into believing that lead production on the Bowes estate was motivated by the opportunity born of war demand rather than peacetime, largely building related, local and national markets, and overseas markets. Yet prices were falling, and the only additional

demand would have been for munitions, an immeasurable factor here, but whatever its level clearly insufficient to counteract any other sources of demand currently not in play, thereby boosting prices. Indeed, Appendix I shows ore production from all but two of the Bowes mines – Closehouse in 1751/52 and Isabell-mea-Hill 1752-56 – as relatively very small from 1747 to 1756, with an upturn in output from 1757 to1759, albeit at a considerably lower level by weight than during the years 1741-46. What could fluctuations in the domestic building market and the overseas market have meant for the Bowes lead business between 1739 and 1760?

There is no current measure of the effect of war demand on lead production, but more can be said about the other primary market for lead – building. Building activity appears to have been connected to war and overseas trade. Building contracted in London, but not in the provinces, during the second half of the 1739-48 war and in 1762-63.[517] Building in London was 'at its lowest ebb' 1743-48, and the Seven Years' War obstructed renewed construction in parts of the capital.[518] The 1739-48 building slump was a consequence of timber shortages caused by war demand for shipping.[519] The idea of higher interest rates in outports and industrialising

areas, like Newcastle, has been posited as causing a decline in construction.[520] It has been uncovered that troughs in building occurred during the War of the Austrian Succession and the Seven Years' War, specifically 1744 and 1762, which, as noted below, coincide with downturns in overseas trade.[521] In general, the demand from the building sector for lead must have dropped significantly for most of the war years.

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[517] A.H. John, 'War and the English Economy, 1700-1763', in *EcHR* 2nd series VII (1955) pp.329-440;
and D. George, *London Life in the Eighteenth Century* (London 1925; 1951 edition) ch. II.
[518] G. Summerson, *Georgian London* (London 1945) p.94.
[519] Wilson, *Apprenticeship*, p.277.
[520] T.S. Ashton, *Economic Fluctuations in England 1700-1800* (Oxford 1959), p.88.
[521] J. Parry Lewis, *Building Cycles and Britain's Growth* (London 1965) pp.17-19.

Understanding the effects of war on the overseas market is critical to an examination of the Bowes lead trade in this period. One conclusion is that war increased the volume of trade generally during the eighteenth century, contradicting the broadly accepted view that war exerted negative effects on economic growth manifested in decreasing investment and personal consumption.[522] An alternative argument is that during the period 1700-1763 war had positive consequences; British sea power acquired markets in North America, Europe – especially Holland and France – and India, with the redirection of mineral products, like lead, into the market created by needs of conflict.[523] Another study of eighteenth-century foreign trade is based upon statistical evidence for 1699-1701, 1722-24, 1752-1754, and 1772-74, purposely selected to negate the effects of war yet suggesting that between 1689 and 1774, despite British success, war 'slowed the overall expansion of trade'.[524] Nevertheless, the supporting statistics show an upward trend in value terms, particularly to North West Europe and Southern Europe, whereas before 1760 the American, Northern European, and East India trade appears relatively stagnant. One study of trends in British economic growth tends to support the view that war acted as a brake on trade.[525] Overall the inference is that war's disruption of trade was a significant factor restricting the growth in English overseas trade in the period 1701-50, that after 1739 'war made trade difficult for most of the following decade and particularly 1744-8', with a recurrence of this effect in 1759 and 1761-2.[526] A more recent study of war and trade points to lead exports to Scandinavia in

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522 W.W.Rostow, *The Process of Economic Growth* (Oxford 1953) pp. 159-160.
523 John, War, pp.329-330.
524 R. Davis, 'English foreign trade, 1700-1774' in *EcHR* 2nd series XV (1962) reprinted in W. E. Minchinton, *The Growth of English Overseas Trade in the 17th and 18th Centuries* (London 1969) pp. 99-120.
525 P. Deane, & W.A. Cole, *British Economic Growth 1688-1959* (Cambridge 1969) p.29.
526 Minchinton, *Overseas Trade*, pp. 13-16.

particular years of the Seven Years War as having been higher than the peacetime levels, both by volume and value.[527] This was countered in a study of the industrial revolution which reiterated that the overriding historical perspective is that the war of 1756-63 had a negative impact on trade and the economy in general.[528] Lastly, the most recent overall assessment of the impact of war on trade concludes that the effects were generally positive, but omits an analysis of the consequences for East coast ports trading to London and Europe.[529]

Perhaps Schumpeter's statistics for the value export values of lead and lead shot during the two wars lasting eighteen years provide greater clarification. Exports by value were only lower than those of 1738 in three years of the 1739-48 war - 1742, 1744, and 1745, with 1744 showing the biggest fall of almost 21%. Those for 1739-41, 1743, and 1746 were all higher than the pre-war level. The 1756-63 war caused more damage to trade in lead: in 1756 the export values were approximately 20% higher than in 1755, after which the trend was downward until 1762-63 when values were more than 10% above that of 1755.[530] Schumpeter's statistics for the geographical distribution of lead and shot exports by quantity and weight (i.e. fothers) reveal a shift in 1740 and 1745 away from the lesser markets of Africa, East Indies, North American Colonies, and British West Indies because of war, whereas the Northern and Central European markets changed slightly, the former three per cent more, the latter almost five per cent less. Exports to Southern Europe were the main victim of war falling by 26%. Exports to all these markets, with the exception of Northern Europe, enjoyed growth in the post-war boom in trade. The distribution of

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527 H. S. K.Kent, *War and Trade in Northern Seas: Anglo-Scandinavian Economic Relations in the mid- eighteenth century* (Cambridge 1973) pp.99-100.
528 J.Mokyr, *The British Industrial Revolution: an economic perspective* (Oxford 1993) p. 56.
529 H.V.Bowen, *War and British Society 1688-1815* (Cambridge 1999) pp.69-76.
530 Schumpeter, *Statistics*, Table VII pp.19-22

exports during the 1756-63 war reflects those for values of lead and shot, in that during 1755-60 Central and Southern European markets shrank approximately 25%, whilst those in Africa and East Indies quadrupled, those to Northern Europe and North American colonies one and half times.[531] Schumpeter's statistics clarify Ashton's remark that during the two mid-century wars exports of both lead and lead shot 'were cut down severely'.[532]

Therefore, it would appear that the overseas market for lead and shot was less affected by war during the 1739-48 than 1756-63; trade only reduced by value in three years of the 1739-48 war, but was higher in six. Exports by value were lower than pre-war in four years of the Seven Years' War, but higher in three. Clearly the overseas market for lead and shot did not disappear during the two wars, indeed for most of the 1739-48 war export values were greater than pre-war, and similarly for three of the 1756-63 war. Burt's study incorporates an analysis of factors which determined the price of lead at ports and the London price, and based upon customs records and parliamentary papers he shows that in 1758 40% of British lead was exported to the Netherlands, which was the primary market for British lead in the mid-eighteenth century. This was followed by the Iberian Peninsular and the Mediterranean markets which received between 20% and 25% of lead exported between 1700 and 1750. He also points to France as an important outlet, even during wartime in 1738-40.[533] Most significantly for the purposes of this discussion, Burt establishes that during both 1739-48 and 1756-63 the average level of trade in lead fell compared to the pre-war level, and that prices fell in both periods. He concludes thus: 'War was a major influence on the size and pattern of the export trade and caused important repercussions for the domestic metal market' and 'in the

[531] Schumpeter, *Statistics*, Table XXVII, p.65.
[532] Aston, *Fluctuations*, p.72.
[533] Burt, *British Lead*, p.236

eighteenth century prices and profits were sustained by export markets'.[534]

The supply of pig lead from Bowes' land was inelastic; the perceived increase in demand could not be met in the very short term because it took time to mobilise labour, sink mines and extend old workings, carry ore, smelt lead, and carry it to market. Equally, the production process could not be terminated quickly in response to market conditions. The key factor here was time. In the short term ore and pig lead output gathered momentum by the expansion of operations mainly at Isabell-mea-Hill. The nature of mineralisation, and the ability to increase ore production at old and new workings were the fundamental contributors in the response to market variations during the 1740s. Again, during Seven Years War of 1756-63, although lead prices were higher at the onset of hostilities, they fell to the same levels as the War of the Austrian Succession 1739-48.

There were effectively two regional markets: a minor market for lead ore and a major market for pig lead. Lead ore was bought and sold, but the bulk of it was bought for smelting into pig lead for market. Generally speaking, the price of ore was determined by the market price of pig lead which was underpinned by the costs of smelting, possibly refining, and carriage to market. In addition, ore preparation through washing and dressing in readiness for smelting influenced its price. Quite often ore was graded according to perceived quality. This outline of the sale of lead ore remains the received view of this aspect of internal trade, and applies to other lead mining areas.[535]

The sale of ore mined on the Bowes estate was essentially controlled

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[534] *Ibid*. p.237 and 243

[535] Burt, *British Lead*, pp. 201-207. Burt describes the sale of ore in Derbyshire, the South West, Wales, and other parts of the North Pennines, and mentions that the factors effecting its price were largely unchanged in the nineteenth century.

by the tacks and leases granted by George Bowes, which are discussed in chapter five above. The prices of bought-in ore, which is both ore from non-Bowes' mines and from Bowes' leased mines, are shown below in Table 11, and the impression is that buying-in was more common in the late 1750s than in previous years. A full series of Bowes' prices for the 1740s and 1750s do not appear in the surviving records. Overall, there was not a significant variation in the price of a bing of lead ore, and the two examples of much lower prices in 1755 and 1758 must relate to the source,

Table 11

Prices of bought-in lead ore from leased Bowes mines and other mines

Year	Mine	Amount of ore			Price/Bing	Value		
		Bings	horses	pokes		£	s	d
1742	Standards	23	0	2	45s	52	17	6
	Arngill	6	2	0	45s	14	12	6
	Dodd Hill	15	1	0	48s 6d	36	19	7½
1755	Rowton Sike	50	0	0	30s	75	0	0
	Isabell-mea-Hill	80	0	0	25s	100	0	0
1757	Lunehead	20	0	0	47s	47	0	0
	Closehouse	20	0	0	46s	46	0	0
	Standards	14	1	0	46s	32	11	0
	Arngill	7	0	0	46s	37	17	1
	Black Ark	21	1	0	46s	40	19	4½
1758	Isabell Mea Hill	45	2	0	44s	100	2	0
	Isabell Mea Hill	56	2	0	42s	118	13	0
	Isabell Mea Hill	21	0	0	35s	36	15	0
	Rowton Syke	20	3	1	various	unknown		
	Closehouse	55	2	0	42s	116	11	10½
	Lunehead	40	0	0	44s	88	0	0
	Arngill		2	0	42s	1	1	10½

Source:
Figures for 1742 are from *D/St/E3/5/21*, for 1755 *D/St/B2/107 & 137*, for 1757 *D/St/B2/120*, and for 1758 *D/St/C3/2/76* and *D/St/B2/127*. Dodd Hill is the only mine listed that was not leased from Bowes and was not on Bowes land.

quality, and possibly short, sharp local market volatility in demand for pig lead, rather than the any factors affecting the general trend. Most prices were within the range of 42s to 46s. In the years 1757 and 1758 bought-in ore was from mines leased from George Bowes which, terms of leases aside, must have been to maintain the capacity of the new mill at Wemmergill. In any event, Bowes was the monopoly buyer of lead ore throughout this period, so when there was a downward movement in the price of a fother of pig lead in the local market he paid less for ore, but price aside George Bowes appears to have been leasing more mines in the late 1750s whilst continuing to finance his own. Consequently, purchasing ore by first option agreement within leases became more prevalent in order to supply the smelt mill.

Comparing the prices of bought-in ore for only several years for which they are available with the market price of pig lead lends some provenance to the mechanism outlined above. There is a very slight tendency to lower prices per bing of bought in ore in the years 1757 and 1758 when there was a minor downward adjustment in the price of pig lead. The correlation between the sale price of ore and the price of pig lead is more distinct in the years 1741 and 1747 and the late 1750s, but to suggest regular linear movement of these different sets of prices either across the period 1730 to 1760 or even during the two wars would be misleading. The absence of price data for most years, and the apparent stability in ore prices in the extant records, supports the view that the reduction in carriage costs achieved by George Bowes prevented having to reduce ore prices, which would have been a disincentive to miners in the same way that excessive duty ore could be. The reduction in carriage costs was the way to increasing profits.

There was another level on which lead ore as a commodity was traded under the terms of tacks and leases granted by George Bowes as mineral lord – duty

ore. In effect this was a royalty in return for permission to mine lead on his estate, and the ore could then be sold or smelted for profit. This was common practice in the North Pennines as a source of risk-free income; duty ore as a Bowes' management tool is considered above in the examination of leases granted.

Duty ore received is listed in Table 12 below together with the then current market value. It should be noted, however, that the amounts and values herein do not necessarily give the complete picture, because some records may not have survived. Nevertheless, it is worth brief discussion as a source of traded ore with a value to Bowes and its importance when the risks of mining were being avoided.

Table 12

Duty ore received by Bowes at various times

Year	Mine	Bings – horses –pokes			Value	£	s	d
1741	Arngill	1	1/12	0	@ 45s	2	8	9
	Standards	3	8/14	0	@ 45s	7	11	0
	Lunehead		13/24	0	@ 45s	1	4	4½
1752	Standards	26	0	0	@ 47s	61	2	0
	Lunehead	2	0	0	@ 47s	4	14	0
1757								
	Lunehead	4	0	0	@ 47s	9	8	0
	Closehouse	4	0	0	@ 46s	9	4	0
	Arngill	3	1	1	@ 46s	7	11	5
	Standards	2	3	0	@ 46s	6	10	4
	Standards	5	1	0	@ 48s	12	12	0
	Black Ark	3	2	½	@ 46s	8	3	10½
1758								
	Lunehead	8	0	0	@ 44s	17	12	0
	Closehouse	17	0	0	@ 44s	37	8	0
	Standards	3	0	0	@ 44s	6	12	0
	Green mines	5	1	0	no data			

Source:
1741 is from *D/St/B2/125* and *D/St/B2/105* accounts; 1752 is from *D/St/B2/149* account of lead bought by Andrew Appleby; 1757 and 1758 are from *D/St/C/3/77* Gibson to Stephenson correspondence

The accounts of duty ore received by the Bowes estate are interesting for two reasons: the values per bing of ore in the years for which they exist match those of bought-in ore and ore sold; and the fact that duty ore was largely a feature of lead mining in the late 1750s. The first point demonstrates consistency of ore pricing in the regional market, with any variations probably due to the quality of the ore. The second point adds credence to the view that the interval between two wars and the early years of the Seven Years War were characterised by a market where Bowes considered that lead was in abundance and investment in mining less viable, hence leasing for duty ore and continuation of mining with a view to the future. It also helps to explain the absence of local sales of pig lead until the late 1750s, and even then in comparatively small amounts when set against the early 1740s. After the War of 1739-48 Bowes occasionally decided to sell more ore rather than smelt it. This is confirmed by the sales of ore to Andrew Appleby at Eggleston Smelt Mill in the years 1752-55.[536] Bowes' mining leases determined that ore mined on their estate was smelted at Bowes' mills; there was no choice or alternative to this practice. Bowes could choose whether to sell ore or smelt it into pig lead, and then whether to sell or store it. He could also decide to invest in opening mines, lease existing mines, or do neither.

Lead ore was also sold by Bowes to others in the lead trade, usually for smelting. The market for lead ore was be local, that for smelted lead was national and international. Table 13 below shows prices, and in most instances sale values, of ore

[536] *D/St/B2/149* Accounts of lead ore sold to Appleby.

sold at different times during the period 1730 to 1758. When these prices are compared to those for bought-in ore in Table 11, it can be seen that there was profit in selling ore, though it was significantly less than the profit in smelting and selling pig lead in the regional and national markets.

In 1730 ore was sold to Lord Viscount Vane by George Bowes and John Buxton who owned one-sixth and five-sixths respectively of Lunehead mine.

Table 13

The price of ore sold

Year	Mine	Amount of ore			Price/Bing	Value		
		Bings	horses	pokes		£	s	d
1730	Lunehead	6	¼	0	63s	19	1	9
	Lunehead	3	2	0	55s	9	12	6
1741	Lunehead	2	0	0	45s	4	10	0
1747	Black Sike	18	0	0	40s	36	0	0
1752	Isabell Mea Hill	40	0	0	47s	94	0	0
	Closehouse	26	0	0	47s	61	2	0
	Standards	7	0	0	47s	16	9	0
	Lunehead	2	0	0	47s	4	14	0
1755	Rowton Syke	50	0	0	55s	125	0	0
	Birkdale	80	1	1	63s	253	3	7 ½
	Standards	12	1	0	50s	35	10	6
	Closehouse	13	1	0	63s	41	14	9
	Arngill	1	2	0	50s	4	7	0
1756	unknown				55s			
1757	Rowton Syke	122	2	0	50s	306	5	0
	Isabell mea Hill				46s			
1759	Closehouse	60	0	0	42s	126	0	0
	Lunehead	20	0	0	42s	42	0	0

Source:
Figures for 1730 are from *D/St/B2/146*; for 1741 *D/St/B2/102*; for 1747 from *D/St/B2/108*; for 1752 from *D/St/B2/149* for 1755 from *D/St/B2/137* and *D/St/B2/149*; for 1756 from *D/St/B2/93*; for 1757 from *D/St/B2/109*; and for 1759 from *D/St/B2/93.*

The ore sales in 1752 and 1755, with the exception of ore from Rowton Sike, were to Andrew Appleby at Eggleston Lead Mill, but the ore from Rowton Sike is noted as having been purchased for 30s and sold for 50s per bing, a 66.66% profit. Lastly, the ore sold in1759 was to a Mr. Park in Durham, who was probably either a merchant or plumber or both. The selling of lead ore was a minor trading activity, perhaps at times when the market for pig lead was not considered to be worth the expense of smelting and carriage to market.

There was also a low level of trading activity in purchasing ore from other sources. George Bowes field agents and specialist stewards often acted as buyers. James Raine, the field agent at Isabell-mea-Hill in 1741 was sent to West Pitts and Weardale 'a-buying ore'.[537] In 1742 just over six tons of ore was purchased from Dodd Hill mine for smelting at Bollihope.[538] When the new mill at Wemmergill commenced operation in 1757 its manager John Gibson wrote to Thomas Colpitts II informing him that ore was for sale at Rowton Sike mine.[539] In 1758, the mines steward Nathan Horn was in a position to buy twenty bing of lead ore near Brough, and before proceeding with the purchase wrote to Bowes' senior steward, Mr Leaton, to confirm the price of pig lead in Newcastle upon Tyne.[540] Clearly, the opportunity to purchase ore would not be overlooked, subject to market prices, but this aspect of the lead trade was relatively insignificant within the overall lead production process on the Bowes estate.

[537] *D/St/B2/103* accounts for Isabell-mea-Hill.
[538] See Table 11 above.
[539] D/St/C2/1/21 Gibson to Colpitts 11th October 1757.
[540] *D/St/C2/3/76* correspondence between Horn and Leaton, and Horn and Stephenson.

The major regional market was for pig lead. The local sale prices per fother of smelted lead are listed below in Table 14, together with prices adopted in the Bowes year-end summary accounts, usually the 31st December, to estimate the value of stock, which was stated as gross profit along with the value of any ore not yet smelted. Prices from Hughes thesis have been included to create a series for the Newcastle market. In 1742 and 1743 there was a range of prices, the wider range appearing in 1743, but the average price for actual sales was quite stable for the period 1741-46. Regrettably, there are no prices for the following five years, but the selling price of Bowes' pig lead was usually lower in 1752 compared to the Blaydon

Table 14

The local prices of pig lead per fother 1741-1760

	Sale Prices	Prices for estimating year end stock value	Prices at Blaydon (from Hughes)	
			Highest	Lowest
1741	£11-15s	£12-15s	£13-5s-0d	£13-0s 0d
1742	£11 to £12-15s	£11-10s	12-15-0	11-0-0
1743	£10-15s to £12-15s	£11-10s	11-17-6	10-10-0
1744	£11-10s	£11-0s	12- 0- 0	10-10-0
1745	£11-5s		11-15-0	11-0-0
1746	£11-5s		11-15-0	11-0-0
1747			11-17-6	11-7-6
1748			12- 2-6	11-5-0
1749			12- 0-0	11-15-0
1750			12-0-0	11-17-6
1751			12-15-0	12-0-0
1752	£10-15s		14-7-6	12-15-0
1753			16-5-0	14-5-0
1754	£15-0s		18-0-0	16-7-6
1755			18-0-0	15-15-0
1756			15-7-6	14-5-0
1757	£15-15s to £15	£14-0s	15-5-0	14-5-0
1758	£13-10s		15-10-0	13-10-0
1759	£14-0s to £11-6s		13-5-0	11-0-0
1760	£13-0s to £12-10s		12-7-6	11-0-0

Source:
Based largely on figures in *D/St/B2/105*, with the exception of 1752 and 1758 which are derived from *D/St/B2/161 (3)*; for 1754 *D/St/B2/160*; for 1757 *D/St/B2/151 (2)*, *D/St/B2/109*, and *D/St/B2/130*; and for 1759 and 1760 *D/St/B2/130*.The prices of lead sold at Blaydon are from Hughes, '*Lead land and coal'*, appendix table 13.

price. By 1757 however, the price had increased to £15-15s per fother, equivalent to a 36.36% rise on the average price of £11-10s-6d in the period 1741-46. The 1757 price

was a 47.62% increase on that of 1752. In 1758 the selling price fell back to £13-10s per fother, but this was still a 16.88% improvement on the average for the first half of the 1740's. The prices of Bowes lead were slightly higher than those at Blaydon in 1759 and 1760.The assumed prices adopted for the purposes of stock valuations demonstrate a similar trend, but are more pessimistic.

The absence of prices for Bowes lead in eight of the years listed is unfortunate, but those available do indicate movements that must be taken as evidence of change in either supply and/or demand. Furthermore, there may have been short-term price volatility. For example, the records showing customers' purchases for the years when prices are available, reveal that in 1743 pig lead was sold at £12 per fother in February and March, but at only £10-15s in July and £11 in September.[541] The market price of lead could have risen or fallen because of carriage problems in a region then devoid of good roads, poor weather, prevailing credit arrangements, dressing and smelting costs, the effects of war, and the value of any silver content. In addition to such short term influences, the seasonality of the mining and smelting process in Upper Teesdale caused logistical problems in mining, washing and dressing of lead ore, and ore carriage, and especially during the winter months. Variations in selling price would point to differences in the

[541] *D/St/B2/147*, in particular the account of Surtees & Atkinson.

quality of the pig lead, which was essentially based on malleability in terms of its fitness for purpose. Again, the purchase ledger for the early 1740's shows pig lead bought 'at several prices' by some customers, and in1759 and 1760 the range of prices at both Dunston and Blaydon reflect the then current market conditions in which sales appear difficult to sustain.

Table 14 also contains prices of pig lead per fother derived from the Hughes thesis, and when these are brought into consideration as supplementary evidence, the lead market landscape acquires greater clarity. In fact, the range of highest and lowest prices of pig lead sold at Blaydon is recorded for the period 1724-78. Moreover, although the Bowes prices for the period 1741-46 are not dissimilar to those for Blackett- Beaumont lead, those available for the 1750s, with the exception of 1757 and 1759-60, are at the lower end of the price range. There was a market for lead, before 1741, which focused on Newcastle upon Tyne, yet no Bowes lead production until 1740/41. The pig lead prices at Blaydon show a downward trend from a range of £16-8s to £13-9s per fother in1724 to £11-15 s per fother in 1745-46, mid-way through the War of the Austrian Succession, then rising steadily to a range of £18 to £15-15s in 1755, on the eve of the Seven Years War. Lead prices rose to the 1755 level immediately after the war and then became relatively stable until 1769.

The records maintained by George Bowes, his stewards and agents, divulge nothing of this market or of any response to changes in price. Lead production on the Bowes estate would seem to have been stimulated by war, yet in both these wars the average price of pig lead was either stable or lower than the pre-war years. The prices uncovered by Hughes for pig lead sales a Blaydon before, during, and after

the periods highlighted in the extant Bowes' business papers clearly indicate that market opportunities for pig lead prevailed, but confirm the variation in prices between times of peace and war.

The market for Bowes pig lead can be identified by the statistics in Table 14 and Table 15 which, when drawn together on a year by year basis demonstrate that of the 7310 pieces of pig lead smelted in the period 1741-49, 5093 where smelted during 1741-44, and of these 2958 or 56.1% were sold in the local market. By extending this period from 1741 to 1746 it can be seen that 6420 pieces were smelted, of which 3236 were sold locally, equivalent to 50.4%, with 1.96% sold directly to a Dane.

The amount of pig lead smelted and sold locally is shown in Table 15 above, together with the cumulative stock i.e. pig lead that could have been held at the staith or shipped out. It can be seen that during the 1740s approximately half of the pig lead smelted and brought to Newcastle was not sold and must be accounted for as stock. Stock levels varied more during the 1740s, and it should be noted that after 1746 another 1139 pieces of pig lead were smelted, of which 791 reached the staith, so further increasing stock levels. This characteristic of a wartime lead market was even more notable in the late 1750s when pig lead was once again accumulated, this time 89% of production. The stockpiling of pig lead could have been a conscious decision Bowes and other producers, such as the Blackett-Beaumonts, or there may have been other causes.

The prices of pig lead listed in Table 14 above, show that the price per fother was quite stable during the years 1741-46, with some variability in 1743, but that in the late 1750s the local price began to fall. The amount of pig lead not sold locally and possibly held as stock, or shipped to London or other east coast ports, is

shown in Table 15 below for the years in which the data is complete i.e. 1741-46 and 1757-60. Unfortunately, Bowes prices do not exist for the period 1747-51, 1753, and 1755-56. This does not necessarily mean there was no market for Bowes lead, either locally or elsewhere, but the gaps in available data could simply mean Bowes records did not survive for those years, although gaps also appertain to ore production, smelting, and expenditure. The stockpiling of lead appears to have been imposed upon George Bowes during both periods of war; a force majeure caused by wartime economic conditions that meant deferring supply until an improvement in demand caused prices to rise. Enforced stockpiling of Blackett-Beaumont lead worth

Table 15

Pieces of pig lead smelted, sold, and cumulative 'stock' at the staith and elsewhere 1741-46 and 1757-60

	Smelted	Sold	Cumulative stock
1741	1666	189	1477
1742	1409	559	2327
1743	1663	2163	1827
1744	355	232	1950
1745	1078	63	2965
1746	249	30	3184
Total	6420	3236	
No data was found for the intervening period.			
1757	700	157	543
1758	1927	10	2460
1759	13	40	2433
1760	112	98	2447
Total	2752	305	

Source: This table is constructed from *Tables 14, 16, and Appendix 3.*

£52,000 at Blaydon was reported in 1760.[542] The prices recorded for both Bowes and Blackett-Beaumont pig lead confirm that in wartime between 1739 and 1748 they were lower than the pre-war years, marked by an increase at the end of the war. This scenario was even more pronounced during the war of 1756-63.

Burt has demonstrated that lead exports fell away during both the War of the Austrian Succession and the Seven Years War, and that this effect was stronger in the latter, whereas in peacetime overseas demand absorbed British lead production and overall exports accounted for half of the lead produced between 1700 and 1750. [543] He

[542] Hughes, 'Lead Land and Coal' (unpublished PhD thesis) p.105.

also notes the effects of war on trade and shipping, and particularly on east coast shipping, and that between 1700 and 1770 Newcastle played the role of second most important lead outport after Hull.[544] Therefore, the sale of lead from the Bowes estate was depressed because of war stifling foreign demand and disrupting the shipping of lead to east coast ports and London, though London's consumption of lead changed very little before 1760, again demonstrated by Burt.[545] This phenomenon is further confirmed by a comparison of the pre-war and wartime volume of merchant shipping leaving Newcastle. It was 26,800 tons in 1744 compared to 42,500 in 1737, and 36,400 tons in 1758 compared to 57,900 in 1751.[546] Burt also argues that British demand did not act as a counterbalance for two reasons; building, the main source of domestic demand for lead, was depressed during wars, as noted above; and the demand for munitions was relatively small, requiring a harder form of lead, argentiferous lead i.e. with silver content, which is an impurity, as opposed to the malleable form needed by overseas buyers for industrial purposes. Hughes study of the Blackett-Beaumont business suggests that ' the requirements of the Ordnance department, though large, were not such as to make up for the loss in overseas trade'.[547]

Newcastle's lead market and its role as an outport for lead to North and North-West Europe deteriorated because of war, particularly the Seven Years War 1756-63. Lead exports direct from Newcastle to these markets shrank; instead local merchants like Peareth & Sorsbie purchased local lead and sold it to London merchants for both the London market and export. Some producers who normally

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543 Burt, *British Lead*, pp. 223-247.
544 Burt, 'Lead Production', pp. 263-264
545 *Ibid.*p.264; London's consumption was on average between 3,000 and 3,500 tons per annum.
546 P.J. Corfield, *The Impact of English Towns 1700-1800* (Oxford, 1982), Table VI p.40. The figures for tonnage include British and foreign shipping.
547 Hughes, 'Lead, Land and Coal' (unpublished PhD thesis) p.114.

traded through Newcastle and Stockton avoided merchants and attempted to sell abroad in their own right. The lead producers in the north-east did not have the lobbying power of the coal trade when it came to threats of increased export duties and the potential loss of foreign markets. Nor was there any association or combination of lead producers capable of controlling lead prices. Prices in Hull, Stockton, and Newcastle fell during 1756-63, leaving producers with stocks they could not move even at lower prices.[548] Demand for lead in Newcastle was especially poor during the years 1760-62. Although Brewer maintains that trade did not decline during the Seven Years War, the conduct of war by the British 'fiscal-military state' incurred the disruption of Newcastle-centred lead production and trade because this region and the London and international markets had become interdependent. The 'workings of the fiscal-military state' were the root cause of eighteenth century trade slumps and financial crises, and 'economic interdependence was such that seismic disturbance in on part of the economy frequently produced eruptions elsewhere'. [549]

In summary, the factors at play in the lead market were local and national demand, overseas demand, lead production and supply, and the effects of war on shipping and the pattern of foreign trade. During the 1740s and 1750s, when George Bowes attempted to manage the growth of lead production on his estate, the export trade in lead, mainly to the Netherlands, Iberia, the Mediterranean, and France and the east coast trade, contracted because of war.[550] Higher prices, therefore profits, were obtained in peacetime when overseas markets were open to trade. Consequently, Bowes lead, along with other suppliers, flooded the Newcastle market which in turn

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[548] *Ibid*. pp.101-105

[549] J. Brewer, *The Sinews of Power: War, Money and the English State, 1688-1783* (London 1989) pp. 189-191.

[550] Burt, *British Lead*, p.236, based upon Customs records and Parliamentary Papers.

caused local prices to fall. The temporary shrinkage of the export market was not replaced by additional local or London consumption, or munitions, and Bowes was left with stock. Perhaps lead prices in London were higher because of wartime insurance costs inflicted upon producers and merchants, but in the absence of such detailed evidence it must be concluded that the price of pig lead and stocks were determined by the external factors of war and the suppression of overseas consumption. Willing or not, Bowes was compelled to hold stock and play the market as circumstances changed and market equilibrium returned, though unsatisfied foreign demand was first to be quenched when war ended. The sudden leap in pig lead prices after the 1739-48 war can be seen above in Table 15, whilst Hughes has noted the same post war price change in 1763.[551] Perhaps Bowes learned this market adjustment and all but discontinued lead production until the late1750s.

The sale of pig lead, metallic lead, in the Newcastle market was the most significant trading activity and the most valuable. In Table 16 below there is a summary of sales by weight and value for the first half of the 1740s and the late 1750s, derived from Appendix 3. These sales were to local buyers only, and purchases made by various merchants are detailed in Appendix 3. There appears to have been a lull in local trade between 1746 and 1757, and the amount of lead sold locally by Bowes was considerably greater in the early 1740s, particularly in 1743, compared to the late 1750s.

The total value of local sales amounted to £2,500-14s 10d in the period 1741-1745, which accounted for 3236 pieces of smelted lead or 226.25 fothers. The

[551] Hughes, 'Lead, Land and Coal' (unpublished PhD thesis) Appendix table 13.

Table 16

Sales of pig lead 1741-1746 and 1757-1760 in pieces and Newcastle fothers

		Weight (21 cwt = fother)				Value		
Year	No. pcs	F	cwt	qtr	lbs	£	s	d
1741	189	12	4	1	21	157	6	11
1742	559	39	2	1	14	384	0	9
1743	2163	153	15	1	14	1732	19	8
1744	232	14	9	0	21	155	7	2½
1745	63	4	9	1	3	47	18	0
1746	30	2	1	2	14	22	5	9½
1747								
1748								
1749								
1750								
1751								
1752	288	18	19	0	7	193	13	7
1753								
1754								
1755								
1756								
1757	157					154	10	10
1758	10					8	8	9
1759	40							
1760	98							

Source: *Appendix 3*

key customer was the firm of Peareth & Sorsbie, a leading Newcastle merchant with strong London connections, bought 2050 pieces or 63.35%, followed by Ralph Carr who purchased 349 pieces (10.78%) Surtees & Atkinson with 274 pieces (8.47%), then Reah & Wilkinson with 180 pieces (5.56%). In the years 1757-60, Thomas Hanby purchased 227 pieces or 72.06% of the pig lead sold locally by Bowes. Hanby appears to have been located in Wolsingham, because in 1760 Nathan Horn arranged for the delivery of twenty pieces there.[552] Once again, Hanby could have been a

[552] *D/St/C2/3/76 (9)*, which is a note written by Richard Stephenson following receipt of a

plumber, or merchant, or both. Peareth & Sorsbie, purchased almost two-thirds of lead sold during the 1740s, bought 288 pieces in 1752.

There are some noteworthy points regarding other evidently smaller accounts, because they reveal the nature of the relationship between Bowes as a lead producer, manufacturers, and local merchants. For example, Ralph Carr (1711-1806) partnered George Liddell in a lead mine on Alston Moor, was a Newcastle merchant and member of the Merchant Adventurers, a hostman in the coal trade, and ship owner.[553] Isaac Cookson & Co. purchased 52 pieces of lead in 1744. Cookson was one of Newcastle's principal silversmiths in the mid-eighteenth century when the town had 'a considerable reputation for the quality of its silverware'. [554] In 1743 Cookson became a partner in a lead mine lease in Middleton-in-Teesdale, and quite soon thereafter this partnership leased land for a lead refinery in Elswick, At this refinery pig lead was desilverised and delivered to Cookson for making his silverware, but they also made sheet lead and cast shot. In 1754 Isaac Cookson died without a male heir to continue his trade.[555]

There is only one example of overseas trade in lead contained in the records examined for the period 1740-60. In 1742, one hundred pieces of pig lead were sold to John Lanet, who is described as a 'skipper', and noted as an order for a Mr. Scott.[556] The same amount is itemised and noted as 'Sold and charged this year to a Dane'.[557] Lead was one of the minerals exported to the Scandinavian market, and one

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memorandum from Nathan Horn. This is re-confirmed in *D/St/B32/150 (1).*

[553] See Purdue, *Merchants and Gentry*, chs. 9 &10

[554] Cookson's workshop was in the Side, Newcastle-upon-Tyne. Noted by Hughes as a maker of silver in *North Country*, p.376.

[555] Rowe, *Lead Manufacturing*, pp.19-20. It should be noted that the lead mining lease to which Cookson was party, was not on Bowes lands.

[556] *D/St/B1/20/168* 'An account of lead received at Geo. Bowes Esq. Staith', and *D/St/B2/147* 'An account of lead delivered to various companies and individuals and to Gibside'.

[557] *D/St/B2/105* accounts ledger.

historian has remarked that the official value of these was in the region of £7,000 to £8,000 per annum during the mid-eighteenth century, and greater in some War years.[558] This was approximately 700 to 800 fothers a year if a price range per fother of £10-£11 is adopted as an optimistic guide, and Beveridge's prices give the actual value as at least twice the official amount.[559] There is no indication of this trade affecting the Bowes estate.

Newcastle-upon-Tyne was the chosen market outlet for both local sales of pig lead and transhipment either to London and east coast ports or overseas. Newcastle was an important lead port, third after Hull and Stockton during most of the eighteenth century. At first glance regional geography and economy would seem to dictate Stockton as a natural outlet for Bowes lead, because it was an established lead port for a significant proportion of lead from North Yorkshire, and because it is situated on the River Tees. George Bowes performed an analysis of the costs involved in transporting lead to both Newcastle and Stockton and chose the former, and his Personal involvement in doing so is discussed below.

At the beginning of the eighteenth century Stockton was the second largest outport for lead: Hull was the leading distributor and Newcastle was in third place.[560] By 1725 the lead trade from both Stockton and Newcastle had decreased by one fifth, but by the mid-1750s both these ports had experienced a huge growth in outgoing lead trade, Newcastle's by 172.5% and Stockton's by 175.2%. Therefore, in 1756 Stockton remained the second most important lead port after Hull, but Newcastle's share of the lead trade was growing apace and by 1770 it had become the second lead port after Hull. Consequently, it seems reasonable to conclude that no

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[558] Kent, *War and Trade,* ch. 6. Kent suggests that lead may have been part of customs fraud an smuggling, because it suffered an export duty of £1 per fother during the mid-century.
[559] W. Beveridge, *Prices and Wages in England* (London, 1939) vol. I pp. 202, 298, and 679
[560] Burt, 'Lead Production', p.257. This paragraph is derived from Burt's article.

failure on the part of Stockton to trade lead coastwise to London or abroad caused George Bowes to sell all his pig lead in Newcastle. What underlies the decision to market all Bowes' pig lead via the Newcastle nexus?

There was a range of circumstances that led George Bowes to choose between the North East's two primary lead ports. Firstly, Newcastle was both a port and a lead manufacturing centre, and consequently as a market it was trilateral. Lead was bought for local consumption, and it could be exported by ship overseas or to east coast ports, including London. Newcastle manufacturers of flint glass and paint needed lead, as well as plumbers manufacturing for general purposes. During the seventeenth and eighteenth centuries Newcastle, and other Tyne ports, were major ship owning and shipbuilding ports, and lead was used for ships fittings.[561]

The northeast was a munitions manufacturing area from the early eighteenth century.[562] By the last quarter of the eighteenth century shot manufacturing was well established in Newcastle, and consequently it seems probable that it was emerging during the mid- Century.[563] The amount of metallic lead moving through Newcastle from the North Pennine orefields force-fed the nucleus of lead manufacturing there, but before 1760 it was not large-scale manufacturing.[564] Stockton, on the other hand, received lead from North Yorkshire and Teesdale, Bowes lead, but 'No lead was manufactured into pipe or sheet in Stockton in the 18th century…..'.[565] Although the lead manufacturing sector in Newcastle was small, the lead trade through Stockton'led to no manufacturing in that town at all'.[566]

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561 See R. Davis, *The Rise of the English Shipping Industry in the Seventeenth and Eighteenth Centuries* (London 1962, reprinted 1972).
562 Hughes, *North Country*, p.61.
563 Burt, *British Lead*, p 248 ff., and Rowe, *Lead Manufacturing*, ch. 3.
564 Burt, 'Lead Production', p. 253; and Rowe, *Lead Manufacturing*, ch. 1.
565 Sowler, *Stockton* (1972) p. 357
566 Rowe, *Lead Manufacturing*, p. 13.

Overall then, Newcastle's hinterland embraced the North Pennine lead mining districts, thereby capturing the lion's share of the trade in metallic lead. Stockton was devoid of manufacturing and offered only the opportunity for east coast and foreign trade, both of which could be restricted during wars, as we have seen above. The Bowes estate in Upper Teesdale contributed to the supply of metallic lead into Newcastle rather than Stockton, because it facilitated all market outlets for it as a raw material.

Secondly, it appears that the structure of the lead trade differed in the two ports. Stockton was an established lead port long before Newcastle, and by the time George Bowes became the family estate's patriarch and instigated greater involvement in lead production, it had developed storage and wharfs owned by Swaledale lead mine owners.[567] There is no evidence of the Bowes family possessing such accoutrements at Stockton. On the River Tyne however, Bowes owned a staith at Dunston, which although devoted to the coal trade, also acted as a lead wharf receiving deliveries of pig lead, the final stage of transportation being the waggonway from Tanfield. Perhaps more significantly, Newcastle was the home of a well established mercantile community in which diverse merchant houses specialised in lead, some in close relationships with London houses, others trading with Holland and Denmark.[568] Merchants such as Peareth & Sorsbie purchased lead from producers like the Blackett-Beaumonts and the Bowes and supplied their London clients for both local consumption and export.

Another feature of the Stockton lead trade was the role of agents who were engaged to act as negotiators when buyers from London lead companies visited

[567] Sowler, *Stockton*, p. 331.
[568] Hughes, 'Land Lead and Coal' (unpublished PhD thesis) p. 97.

the port.[569] We will see below when George Bowes' entrepreneurial role is examined, that he rejected, on the grounds of cost, the need to employ agents if he wanted to trade via Stockton. In Newcastle there was a merchant community that dealt in lead as one of multifarious activities, and those to whom Bowes sold lead have been named wherever records permit.[570] George Bowes sometimes acted as an agent or broker in Newcastle, particularly during the early1740s.

The last link in the process of trade through Newcastle was to ship out lead either to east cost ports or London. Obviously, because of George Bowes involvement in the coal trade he had immediate access to shipping, indeed Bowes operated his own fleet. Suffice to say that in so far as the shipping of lead was required, Newcastle was the most suitable outlet for Bowes lead.

Transport by ship was only one consideration in marketing pig lead; the pattern of inland carriage mattered because it preceded the movement of lead by water. Although maps clearly indicate that the carriage of lead from Upper Teesdale to the River Tyne was a shorter voyage for the caravans of packhorses or carts, the terrain was less difficult to Stockton. Newcastle appeared the natural gateway for lead, yet Bowes did not initially ignore the possibility of the Stockton outlet. It seems to have been, along with the necessity for agents, potentially the first

choice port.[571] Yet all the records for pig lead smelted and carried to market show only the River Tyne as its destination. George Bowes made his choice of port based on careful considerations: assessments of routes, distances, and carriage costs. These

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[569] Sowler, op. cit.

[570] E. Hughes, *North Country Life in the eighteenth century, Vol. II, Cumberland and Westmoreland* (OUP 1965), pp.29 and 53. Hughes discusses the links between a Whitehaven merchant and those in Newcastle during the 1730s and 1740s.

[571] *D/St/B2/159* 'a good for nothing paper as a curious precedent for keeping a smelt mill account' drafted as a model document, probably in 1741. It refers to Stockton, its 'agent system', and 'bullion'.

are discussed below when his direct involvement in the lead business is considered. A particular aspect of such analysis compared the carriage costs of pig lead to Stockton and Newcastle.[572] This supposes twenty-two pieces of lead of 112lbs each (i.e. 8 stones), which equates to a Stockton fother of 2464lbs (22 hundred-weight), via Wolsingham and Tanfield Moor, and then by waggonway to Dunston. The alternative journey to Stockton via Eggleston, Staindrop, and Darlington supposes eighteen pieces of 140lbs (i.e.10 stones), which equates to 2520lbs (22½ hundred-weight), whereas a Newcastle fother was 2352lbs. In fact, 2520lbs was a Derbyshire fother of lead. Bowes concluded that the route to Newcastle cost £1 6s 1d and that to Stockton £1 1s 4½d;in other words the journey north was 4s 7½d or 22.4% more expensive. As seen above, if this calculation was the basis of a decision to re-direct lead to Stockton, nothing changed during the 1750s.

During the 1740s and 1750s Newcastle was the outlet for Bowes lead, because it had become the nexus for the lead trade from the Northern Pennines with pig lead supplied as a raw material by the Blackett-Beaumont, London Lead Company, and Bowes enterprises, the latter evidently producing the smallest contribution. Newcastle was the portal for three markets: the local market consisting of consumption of manufacturers, plumbers, and general uses; east cost ports and London; and the overseas markets. In addition, Bowes' existing arrangements on the quayside and relationships with lead merchants, together with personal involvement, meant he was compelled to direct lead produced on the Bowes estate through Newcastle rather than Stockton. And of course, the Bowes family had traded in lead from Newcastle since the sixteenth century.

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[572] *D/St/B2/148* 'Account of the expense of carrying lead to Newcastle, Stockton, etc.'

It is possible to identify four stages of transportation in the lead production process; the journey of ore from the mines in Upper Teesdale to Bollihope, which was broken into two sub-stages, namely 'Teesdale carriage' and 'Weardale carriage'; pig lead from Bollihope mill to Wolsingham; pig lead from Wolsingham to Shield Row; and pig lead from Shield Row to the staith on the River Tyne.[573] The stages of transportation changed after 1757 when the new smelt mill at Wemmergill began to receive all the lead ore from the Bowes estate. The ore was Carried a much shorter distance, but the smelted lead a longer distance from Wemmergill to Wolsinghahm, Wolsingham to Tanfield, and from Tanfield to the Staith.[574] In other words, there were still four stages in the carriage process, but by far the shorter was ore carriage, always the mot difficult and most expensive by weight. There is some indication that on occasion on the Wemmergill to Wolsingham section, pig lead was carried from Wemmergill to Mickleton then to Wolsingham, but in smaller amounts of two pigs or thirty-two pieces.[575] The collection from Mickleton appears to have been irregular and should necessarily be seen as part of the carriage staging. There is no record of Bowes pig lead carried to Stockton, although from outset Bowes was faced with the choice between transporting lead to Newcastle or Stockton. The latter may have appeared the obvious option, but as we have seen Newcastle was chosen as the regional market and outlet to London and beyond. George Bowes' analysis of this problem is discussed below when assessing his role in the development of lead production on his estate and its contribution to the growth of the lead industry in northeast England during the mid-eighteenth century.

The recorded movement of the product gauges to some extent the Bowes response to market conditions in Newcastle. During 1741-42 Richard Dobson

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573 *D/St/B2/103* report of carriage and *D/St/B2/125* pay bill for ore carriage to Bollihope mill.
574 *D/St/B2/150* and *D/St/B2/127*, accounts of pig lead carriage costs
575 *D/St/B2/127* smelt mill pay bill for 1757/58.

was responsible for carrying 2702 pieces of lead to Dunston Staith.[576] At the end of 1744 1888 pieces of pig lead were resting at the staith, and at the end of 1745 2860 pieces were at the staith. Pig lead was carried to the staith via Wolsingham and then Shield Row, where it was put on to the waggonway to the Tyne. The deliveries to the staith indicate a steady movement of lead from smelt mill to market during the 1740's, and all but 136 pieces of lead reached the staith. After 1746 the movement of pig lead slowed somewhat, probably because orders were not forthcoming and lead stocks were growing. Moreover, it suggests that supply exceeded local demand, that is both on Tyneside and at Stockton, and that the excess pig lead was held in stock at the staith in readiness for shipping either down the east coast or abroad as war drew to a close. Indeed, the fall in the percentage of pig lead sold in the local trade from 56.1% to 50.4% when comparing 1741-44 with 1741-46 tends to support the view that supply was greater than demand as the 1740s progressed.

The statistics for the late 1750s create a different view of the trade in pig lead, because of the 2752 pieces smelted during the years 1757-60, only 1173 are noted as carried to the staith by March 1760, although it had reached Tanfield Moor via Wolsingham.[577] By the end of 1758, however, there were 2166 pieces of lead resting at Dunston Staith valued at £1,568 –11s –5d (or 104.5 tons at £15 per ton).[578] More significantly, only 305 pieces or 11.1% of the pig lead was sold locally. It would appear that the movement of pig lead to the staiths was somewhat slower, which in turn suggests a different set of market conditions when compared to the 1740s. In other words, 88.54% of pig lead produced during 1757-60 was not sold locally. Clearly, this bears no resemblance to the level of local trade in the first half of

[576] *D/St/B1/20/168*, record of lead delivered to Dunston Staith.
[577] *D/St/B2/150*, an account of lead smelted and led from Wolsingham to Tanfield Moor.
[578] *D/St/B1/20/169* record of lead resting at the staith.

the 1740s. Consequently, the bulk of pig lead must have been held as stock.

Bowes lead was marketed in Newcastle where it was purchased by merchants for sale in London, for consumption there and exports, sometimes on behalf of London merchant houses. Peareth & Sorsbie were the leading firm in Newcastle, buying Bowes and Blackett-Beaumont lead and acting for London merchants. Newcastle's lead manufacturing industry must have also been supplied by the city's lead merchants, but it is unclear which of those named in Bowes records were active in this corner of the local market. George Bowes was personally involved in marketing of Bowes pig lead during the early 1740s; his own memoranda and correspondence with his stewards indicates a role as merchant or broker in Newcastle.

Records of prices, sales, and stocks between 1740 and 1760 further evidence the effect of war on the lead trade, and particularly the Newcastle market. Although the London's consumption remained unchanged, and the needs of war created some extra demand for munitions, they did not replace the temporary absence of the overseas markets cut off by war and shrinkage in the demand for lead from building in certain years of wartime. Lead producers in the northeast oversupplied the Newcastle market as prices of pig lead fell, which induced stockpiling, a phenomenon only relieved by immediate post war booms when foreign demand was reinstated in the market mechanism for lead. Excessive supply also occurred at Stockton, consequently it did not offer an alternative outlet for Bowes lead.[579]

The effect of the Seven Years' War was more severe than that of 1739-48, when it seems that the disruption of normal trade meant the only market for Newcastle lead was London. Bowes lead relied upon the operation of its local market, but its ranking was behind Blackett-Beaumont amongst Newcastle merchants

[579] Hughes, 'Lead, Land and Coal' (unpublished PhD thesis) p. 104.

who gave the latter preferential treatment n sales to London.[580] The Bowes reaction to

wartime interruptions was tantamount to a withdrawal from lead production until the late 1750s.

The variation in prices during wartime demonstrates just how risky trading in lead could be. Yet there is no sign that Bowes lead production responded to post war booms and peacetime price adjustments. It may have been that following the Bowes experience of the 1739-48 war, George Bowes considered the whole business too risky. During the inter-war years the level of activity in mining, smelting, and trade was negligible; ore was sold off locally, there was no Bowes smelt mill in operation, and the Bowes family were not investing in lead production. Before the 1756-63 war ended, however, there were indications of a reinvigorated approach, though relatively small scale, and even then the movement of lead to the Tyne was slower than during the previous war. In any event, as already noted, Bowes was probably not in a position to lobby for the lead trade in the way he could for coal, nor was there an association of lead producers supplying Newcastle that could have influenced prices.

[580] *Ibid* pp. 97-98

Chapter 8: George Bowes - Progressive Patriarchy

George Bowes is a noted figure in the eighteenth century economic and social history of northeast England, which has been largely illuminated through the histories and papers of various landed and merchant families.[581] His importance is attributed to the significant role he played in the coal trade as a partner in the Grand Allies.[582] George Bowes has been described as 'one of the meteors' of this trade.[583] Another historian labelled him as 'a prototype of the swashbuckling tycoon', because he had an eye for a quick return and a willingness to incur the wrath of peers and partners to achieve it.[584]

The description 'tycoon' is an apt nomenclature as George Bowes was undoubtedly wealthy, powerful, and influential at local and regional levels, and in London's financial and political arena. His life and achievements are summarised in Wills' architectural history of the Bowes' estate at Gibside, and in particular his plans to develop this substantial residence as the family seat and flagship of his family's wealth, power, and social status amongst the North's commercial elite.[585] He was the wealthiest commoner in England by the time of his death in 1760.

The only general history of the Bowes family sets out neither to investigate George Bowes as custodian of family wealth nor his development of the

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[581] See E. Hughes, *North Country*; A. W. Purdue, *Merchants and Gentry in North East England 1650-1830* (University of Sunderland 1999); M. Hughes, 'Lead, Land and Coal' (unpublished PhD thesis); R. King, *Aspect of sociability in North East England 1600-1750* (Durham University unpublished PhD thesis 2001).

[582] Hughes, *North Country*, Chapter V. See also, Flinn, *British Coal Vol. 2*, and J.U. Nef, *The rise of the British Coal Industry* (London 1932). D. Levine &. K. Wrightson, *The Making of an Industrial Society: Whickham 1560-1765* (Oxford 1991) is probably the best authoritative account of the Grand Lease.

[583] *Ibid* p.163

[584] J.T. Ward and R.G. Wilson, *Land and Industry: the Landed Estate and the Industrial Revolution* (Newton Abbot 1971) p. 104.

[585] M. Wills, *Gibside and the Bowes Family* (Society of Antiquaries of Newcastle- upon-Tyne 1995) chapter 2 deals with George Bowes achievements. This is based on Dr. Wills' Three generations of the Bowes family (Newcastle University PhD 1988).

estates' lead resources.[586] One study of George Bowes' role in the northeast coal trade represents him as an absentee landowner and coal magnate who spent his time in London as an MP and lobbyist for the coal interest enjoying a lifestyle commensurate with his wealth.[587] This depiction rests on the argument that, from about 1736, following the merger of Bowes family collieries with the Grand Allies, George Bowes extracted himself from business life completely. To some extent, this argument is given weight by the oft accepted view that he preferred country life in the Northeast to London society and Parliament. [588] In other words, he absented himself from business

whether at home or in London. Oldroyd's very recent work regarding accounting methods used in estate management during the George Bowes era offers a more detailed analysis and contradicts the view that George Bowes was an absentee from the coal trade, hailing him as a strategist and the estate's management as highly efficient. He provides an insight into the importance of this aspect of estate operations, and although accounting procedures were important tools in Bowes' business control, this work reveals nothing of George Bowes' personal role in the lead business. [589]

The purpose of this chapter is to examine George Bowes' involvement in the family estate's lead business, in production, in the market, and in management at strategic and operational levels, which hopefully will allow a judgement to be made regarding his entrepreneurship and its consequences for the Bowes estate both regionally and nationally. George Bowes was not unique in his exploitation of lead,

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[586] *Streatlam and Gibside: The Bowes and the Strathmore Families in County Durham* (Durham County Council publication 1980).

[587] G. Bennett, E. Clavering, & A. Rounding, *A Fighting Trade: Rail Transport in Tyne Coal, 1600-1800 vol. I, History* (Gateshead 1990)

[588] Wills, *Gibside*, ch.2; R. Surtees, *History and Antiquities of the County Palatine of Durham*, 4 vols (London 1816-40), see vol. 2.

[589] Oldroyd, *Estates*.

yet this analysis confronts his alleged absenteeism by indicating his lead business activities whilst in London, revealing him as both entrepreneur and estate manager, and suggesting a role linking the Newcastle and London lead markets. Bowes was a mid-eighteenth century commuter travelling regularly between the northeast and London and even rented a half-way house at Ledstone near Nottingham.[590] He was an entrepreneur and strategist for the Bowes estate's management of lead production, but also directly involved in the various stages of mining, washing and dressing of ore, smelting, transport, and marketing.

George Bowes' strategic thinking is evident throughout the period 1740-60. As early as 1742 George Bowes was questioning the viability of smelting ore from the mines on his estate. On 'Mr. O'Neal's Acct. of ye Lead Mills 1742', he wrote:

'Q. if not to my Advantage to lay in my Lead Mynes.
To consider if it not be proper to carry on ye Myne
& lay of ye oar after its washed in ye Mills shop'[591]

We know that at this stage he did not decide to farm the lead ore then sell it, but probably considered it because the only productive mine in 1742 was Isabell-mea-Hill. His alternative was to take a very short-term view and take immediate profit from this mine and avoid future costs of smelting and carriage.

Some documents present us with a broader understanding of George Bowes' perspective on lead. For example his memorandum of 10th August 1748 covers finance, projected ore values, and involvement with another lead mining family, and an instruction to the recipient to ask 'of Mr. Leaton whether he got any

[590] Wills, *Gibside*, ch. 2
[591] *D/St/B2/155* an account of lead ore delivered to Bollihope Mill.

share of Mr. Blackett's Agents for ye part of the work in my Lead Mynes'.[592] He goes

on to mention working through limestone at Black Syke 'which will cost Forty to Fifty pounds', and adds 'The present loss …..is £7 3s 4d…… (for) 18 Bing of Oar got'. Then above a sketch map of Rowton Sike Bowes wrote a projection of ore production and value as follows:[593]

'Oar supposd to be got in 1754.

Isobell May Hill 80 Bing at 25	£162	
Standards Duty 8 at 58s p. Bing	23	4
Close House Bing getting 40s	13	16
Arngill a Bing Duty at 58s	2	18
Rowton Syke supposd 20 Bing at 13 profit	33	
	224	18

George Bowes' lead business strategy seriously considered the widening of his smelting operations away from his own estate; the building of a smelt mill near Keswick, and one in particular at Thornthwaite. The plans and itemised costs ranged from £99 15s 7 ¼d to £170 4s 0d, considerably more expensive than most of the figures for mills on or near his estate, but there is no confirmation that Bowes did expand his smelting operations. Indeed, it may have been that his interest in the Keswick mining area related to copper rather than lead, although the the smelt mill plans would indicate lead.

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[592] Mr. Leaton was one of Bowes' stewards responsible for visiting mines and farm tenants. 'Mr. Blackett' was the owner of mines in Weardale and Alston. There is no record of the joint venture Bowes mentions in his memorandum.

[593] *D/St/C1/3/60*

Documents created by George Bowes and his estate stewards, when conflated prove that he was directly involved in the lead production process – mining, smelting, carriage and marketing; that he directed the management of miners, washers, carriers and smelters; that he was informed by and communicated with the various individuals in the lead management framework; that he was in a range of different mining partnerships as a means of spreading risk; that he carried out reviews of his lead business and controlled financial management, particularly costs; and that he behaved as a capitalist through tacks and leases and the putting out by agreement of tools and equipment.

George Bowes often directed the arrangements for mining - tacks and leases - by instructing their contents. Management of mining was left to stewards and specialists stewards, but most leases were at the instigation of Bowes himself once he received an offer from potential lessee adventurers, often supported by information from an agent or steward. Whilst at Streatlam during the summer of 1748 George Bowes penned 'Memds. relating to my lead mynes and tack notes granted'[594] which consists of a detailed list of mines and the lessees to whom he had agreed to let the mines, including Arngill, Standards, Lunehead, and Closehouse. Again, in 1751 Bowes confirmed that Arngill was available for let at 'Fifth Duty for any terms not exceeding 21 years the first year at a sixth'. His mines steward Nathan Horn was to carry out this instruction by acquainting any interested person with these terms. Bowes had personally directed Horn to make it known that he was willing 'to let….. any part of ye Lordship for a Fifth Duty for 21 years or seven years lease for a sixth Duty'. [595]

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[594] *D/St/B2/21* memoranda by George Bowes on lead mine leases
[595] *D/St/B2/21*

In 1756 George Bowes renewed his interest in lead mining following a lull in production after 1749 when the market had been flooded with pig lead. He implemented a change in strategy by instructing Nathan Horn in detail about the letting of his lead mines, and once again focused on the two elements which most interested him, namely the gain and the costs involved.[596] This signalled a change in Bowes' view of how the lead mining industry should be organised on his estate. Rationalisation of the actual mining process became the favoured approach; evidently letting more mines, with the exception of Isabell-mea-Hill and Closehouse, for duty ore as the preferred basis of production. His decisiveness is abundantly clear from the memorandum:

'Lead Mines
Green Mines on tak by Mr Craddock & pars
at every 1/6 duty.
Isables Miah Hill on tak till May day 1758
at 25s per Bing
Black Ark upon Cronkly Scar on tak
for two years at every 1/6th duty ending
at Lammas 1758
Black Syke Mr. Tissington & Pars. at every

[596] *D/St/B2/93(1 & 2)* a copy of George Bowes' memorandum to Nathan Horn dated 16th October 1756. The original was copied in the handwriting of Richard Stephenson, the senior steward at Gibside.

1/6th duty for 21 years Commenced at

Lammas 1755

Nick HoppleYard let to do. do.

White Pitts near Noon Hill do. do.

Close House let to Jonathan & Co.

at ever 1/6 duty for 3 years ending

one year expir'd

Sun Vane at Close House Let to Nichs. Furnice

at 40s per as Bing Not Wrought

Standards let to Sam. Bacon for 21 years at 1/6 duty

about ½ year expir'd.

Arngill to let at 1/6 duty

Lune Head let to Chas. Wensley for 21 years

enter'd at Midsummer 1753.

Old Field east of Mine Hill Let to Cha Wensley

For 5 years enter'd two years ago at 1/6 duty'

At the same time, as part of the renewed vigour for lead, Bowes began the building of a new smelt mill at Wemmergill.

George Bowes' commitment to investing in the expansion of lead production on his estate through exploration and mining is confirmed by expenditure accounted for in the period 1731 to 1758, itemised below in Table 17. The total expenditure on lead mining was £4,869 12s 8¾d, of which Bowes' partners at Lunehead, Nichol Hopple Yard, Standards, and Rowton Sike at Lunehead, contributed only four per cent. The investment of working capital began in earnest

with the discovery of an accessible lead vein at Isabell-mea-Hill in 1741, but was reduced after1745 and did not reach the level of the early 1740s until 1757. Investment through partnership was largely a feature of the late 1730s at Standards and Lunehead which each lasted for a year, and for brief periods at Nichol Hopple Yard, Crinkle How, and Black Sike in the late 1740s.

Table 17

Lead mining expenditure on the Bowes estate, including partners, during

1731-1758

				Partner contribution		
	£	s	d	£	s	d
1731	8	3	1			
1737	12	19	7	12	19	7
1739	351	0	11	23	8	8
1741	986	10	8	2	4	8
1742	534	8	7			
1743	357	14	11½			
1744	310	17	11			
1745	225	12	11½			
1746	168	16	5			
1747	23	19	4	47	18	6
1748	106	14	2	18	12	0
1751/52	165	17	7			
1752/53	191	16	1	18	13	10½
1753/54	34	6	2			
1754/55	177	4	6			
1755/56	190	14	7¾			
1757	423	12	11	27	6	11
1758	405	2	9	42	15	3
TOTAL	4675	13	¾	193	19	5½

Source:
D/St/B2/102-122, with the exception of 1758, which is from *D/St/C2/3/76*. The years 1756-61 are indicated so because the compilation of accounts was December to December. Expenditure at Closehouse in 1751/52 included workings at nearby Thringarth.

Table 18 below summarises the expenditure relating specifically to the getting of ore during the period 1731-1758, and clearly demonstrates that George Bowes, sometimes with partners, was committed to investing in the continuance of

Table 18
Bowes' lead mining expenditure by mine for ore production, including partners, 1731-1758 (excluding carriage and smelting)

				Partner contribution		
				£	s	d
Arngill	47	7	1			
Black Ark	50	12	4			
Black Sike	33	5	3	66	10	8
Closehouse	236	18	1			
Crinkle How	97	8	2			
Cronkley	29	10	1			
Green Mines	131	3	8			
Isabell-Mea-Hill	3186	11	4			
Little Street	4	19	4			
Lunehead	407	0	11	23	8	8
Nichol Hopple Yard	11	2	0	2	4	8
Rowton Syke	355	0	3¾	88	15	10½
Silverkellwell	4	19	4			
Standards	41	7	1	12	19	7
Side Lead Mine	37	18	0			
TOTAL	4675	13	¾	195	19	5½

Source: *Appendix II*

lead mining on his estate. The mine at Isabell-Meah-Hill was the main recipient of working capital, mostly during the 1740's, although there was further investment in this mine during the 1750's, albeit at a lower level. Across almost two decades sixty-eight per cent of capital was sunk into Isabell mea Hill, Rowton Sike and Lunehead almost ten percent, and Closehouse over five per cent. Lunehead, and Rowton Syke, which is also in the Lunehead area, were considered worthy of development, but to a much lesser extent when measured in terms of expenditure. The more detailed annual data in Table II of the appendices demonstrates the comparatively narrow focus of expenditure in the 1740's on Isabell-Meah-Hill, whereas during the 1750's the distribution of working capital broadened to include other mines, particularly those at Rowton Sike, Black Ark, Black Sike, and Closehouse, when Isabell-mea- Hill was less consuming. Again, it must be reiterated that capital input at Isabella Meah Hill occurred largely during the 1740's when it was by far and away the principal lead mine in terms of actual and potential lead ore production.

George Bowes' willingness to speculate in lead is unquestionable. He appears, however, to have to have overlooked a mining opportunity in Westmoreland. One Joseph Bowes, of no relation, offered it to him in 1758 as a short treatise, entitled "some Leadmines in the Duke of Bridgewater's possession".[597] It amounted to an opportunity for a set of gentlemen with money to venture to take an eighteen-year lease to mine lead at a place called Scoregill, near Dufton, in Westmoreland, no more than ten miles from Wemmergill smelt mill. The source, Joseph Emerson of Newbigin, near Middleton-in-Teesdale, was 'looked upon by all the Earl of Darlington's agents to have the most Knowledge in Mines of any man in the North of

[597] *D/St/C2/3/75(6)*, treatise from Joseph Bowes dated 14th January 1758, sent by Elizabeth Horn of Middleton-in-Teesdale 'on behalf of an acquaintance' (i.e. Joseph Bowes) to Richard Stephenson.

England'.[598] He was probably working at Pikelaw lead mine for the Earl of Darlington.

Emerson believed that Scoregill was 'the most promising thing that any Gentlemen can chance money in ….', because most of the exploratory work at different levels had been completed, though largely unsuccessfully, which could facilitate success. Emerson wanted a quarter share in the suggested enterprise. Joseph Bowes suggested that Nathan Horn should be sent to assess the mine and contact the Duke of Bridgewater's agent.[599]

A final point is that when the figures for ore production at the various mines are compared to those for working capital introduced by Bowes or Bowes and partners, it can be seen that in most cases there was not a long gestation period. Ore was generally harvested within the very short term if not immediately. This was certainly the case at Black Sike in 1747/48, at Closehouse between 1751 and 1759, at Standards in 1758/59, at Black Ark in 1757, at Isabell mea Hill throughout the 1740s and 1750s, and at Green Mines in 1751/52. Expenditure at Crinkle How in 1748/49, at Lunehead and Closehouse in the 1730s, at Nichol Hopple Yard and Green Mines in 1741 and 1757/58, all proved fruitless, but in most cases offered the benefit of continuity of exploration and discovery either for a future date or for lessees keen to develop a mine's potential. The effects of war and peace for the lead market have been discussed above in Chapter 7, and it has been established that, using the example of Isabell-mea-Hill mine, production costs were well below market prices. Yet mining activity on the Bowes estate does not appear to have been particularly responsive when lead prices rose substantially as war ended. This is more noticeable in the case

[598] Extracted from the text of Joseph Bowes' treatise in *D/St/C2/3/75(6).*

[599] *D/St/C2/3/7 (8)* Richard Stephenson's letter to Joseph Bowes of 8th February, confirming that George Bowes was too busy involved in a lawsuit, but would possibly consider the matter later.

of the war ending in 1763 than that ending in 1748, but in both instances we should seek the cause internally rather than externally, in management rather than market.

George Bowes was regularly involved in lead mining operations by gathering reports from his mines steward and senior estate stewards, and by giving instructions that would allow him to form his opinion of the potential for profitable lead mining. In 1746, for example, a steward noted his master's instructions as 'Orders to me on going to ye Lead Mine pay', in which Bowes requests 'bring me another of Wensley's boring & Nathan's opinion of Ditto.[600] Bowes undoubtedly had faith in his own judgment, but was sufficiently astute to obtain his specialist steward's view of Charles Wensley's prospecting at Lunehead, before he committed to further leases or provision of working capital. Similarly on a 'A plan of Langstaff Tryall near Standards' Bowes wrote orders about actual mining operations there:

> '22s p. fathom for driving ye drift to flank
> ye vein which is supposed to be near twenty
> fathom.
> Such work tools as are delivered them to
> Be then valued & to be made good when returned
> in ye paymt for their working'.[601]

Having gathered information and a sketch map of the proposed mining and determining the scale of the task, Bowes decisively set the rate of pay for the deadwork and provided the tools, which had to be returned before the miners were paid.

George Bowes was evidently the chief source of working capital for

[600] *D/St/B2/91(1)* a memorandum in Bowes' own hand, dated by archivists as c.1740 but more likely c.1746 when cross-referenced with Charles Wensley's leases at Lunehead.
[601] *D/St/P15/3* a sketch of trial workings at Langstaff near Standards dated at mid-eighteenth century.

lead mining on the Bowes estate, but directed a different strategy during the 1750s which introduced the transition from small scale to larger scale production marked by a concomitant change to extraneous sources of investment. The Bowes estate before George Bowes and during the first thirty years of his patriarchy did not experience the evolution described by Burt as the demise of small-scale local finance, which had characterised the industry since the sixteenth century, replaced by the larger scale regional and sometimes national finance, enterprises formed by investors from the professional classes, merchants, and the gentry. The reason for this change was the capital requirements of deeper mining and the reluctance of mineral lords to carry the risks involved.[602] Rather, it was representative of Raistrick & Jennings' three categories of investor: the working miners who's capital was their skill and simple tools; the mineral lord seeking to develop and exploit his estates; and from the late seventeenth century, the sleeping investors, who often speculated individually, but more often came to share the risks by forming partnerships and, far less frequently during the eighteenth century, joint stock companies.[603] These sources were usually local and included smelt mill owners and merchants willing to risk some of their gains made in other sectors of the local or wider regional economy, but the key role was played by the landowner, in this case George Bowes. The circumstances for change created by George Bowes are divulged in the contents of tacks and leases which state the types of adventurer and in many cases their place of origin, and when those for the 1740s and 1750s are compared and contrasted a change in the type of lead mine adventurers and the scale of their enterprises can be identified. [604]

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[602] Burt, *British Lead*, ch.2.
[603] Raistrick & Jennings, *History*, ch. 8
[604] The following examination of sources of capital and business organisation is from *D/St/B2/11-31 and D/St/B2/105.*

In the 1740s, with the exception of George Bowes' mine at Isabell-mea -Hill where for two years he was in partnership with John Dent, most mining activity was small scale with relatively low ore production. Thomas Taden (sometimes written as 'Tedding') and Jonathan Watson prospected as partners in the Wemmergill and Arngill Beck area of Lunedale in 1738. They were skilled miners, and Watson was a specialist husher. Similarly John Longstaff, also a husher, worked the area lease granted in 1738, which embraced the Green Mines and Birkdale orefields. In 1744 Taden, Watson, Longstaff, and Thomas Raine combined to work the High Hush at Lunehead. In between leases Watson worked for George Bowes at Black Sike where he had a bargain in partnership with Ned Robinson to work twenty fathoms at 10s a bing and 8s a fathom. In 1748 Taden and Watson were hushing at Standards, and in 1755 Watson took a three-year lease at Closehouse. These are examples of small-scale, low cost exploration and exploitation; the capital commitment was in the form of skill, labour, and basic tools from independent, self-employed, possibly part-time miners.

Charles Wensley, described in leases as a miner, was at Level Head Lunehead from 1746-48, at Rowton Sike Lunehead from 1752 where he became George Bowes partner in 1755, and from 1754 on the Old Field at Lunehead from 1754. Indeed his exploits resulted in Rowton Sike becoming known as Wensley Vein. Wensley was a serious miner but lacked working capital, and consequently the partnership was formed because Bowes was convinced of the potential at Lunehead and Wensley could not have continued mining without Bowes money. It would be inaccurate, however, to categorise George Bowes as a sleeping partner, because he was au fait with lead mining and was represented in the field by knowledgeable agents whose direct oversight was written into the lease with Wensley. Charles

Wensley appears to have been a full-time lead miner who required partnership funding to develop his mining operation.

The third type of adventurer on the Bowes estate in the 1740s was the salaried Bowes field agent who both worked for Bowes in an overseeing capacity at the leased mines, and who actually worked as a miner. The most obvious example is Nathan Horn, who eventually became George Bowes lead mines steward, who worked Arngill with Robert Hind and John Dent from 1742 to 1744. Another was William Horn, possibly related to Nathan, who acted temporarily as an agent for George Bowes, and who in 1741, in partnership with Edward Rain who had discovered this vein, also took a lease from Bowes north of Long Crag near Lang Hurst, probably what came to be know as Millings Shop. He was also involved in a trial mine on Mickle Fell, the exact location unknown, in partnership with Leonard Robinson, Thomas Horn, possibly a relative, and Jonathan Watson the husher, the tack note for which became extinct in October 1746.

There was almost one notable regional source of finance. In 1739 George Bowes received a proposal for a tack from William Coatsworth, the successful Newcastle businessman, and his partner John Dixon, to work Lunehead lead mines for six months with an option for a twenty-one year lease and one-sixth duty ore Bowes. Unfortunately there is no record of a response from Bowes, nor is there any evidence of Coatsworth and his partner mining at Lunehead. [605]

The independent miners, possibly dividing their time between lead and land, the miner devoted to chasing the lead vein, and Bowes field agents with mining skills and knowledge were all local. In 1748, however, the allure of lead

[605] For William Cotesworth's activities see Hughes, *North Country*, ch. II and V, and Purdue, *Merchants and Gentry.*

saw the arrival of a partnership that was granted a two-year lease to mine at Arngill, and at least one of the partners was London based - John Dent 'of ye Gate'.[606] Dent was probably a merchant in coal or lead or both, so would have been aware of the value of lead in the 1740s when demand was high in the post war boom. This partnership is the only clear example of an investor who was neither local nor regional, and was the first sign of the influx of adventurers from outside the North East.

At the beginning of the 1750s lead mining on the Bowes estate appeared moribund; ten years mining at Isabell-mea-Hill had come to an abrupt end; the tacks at Arngill, Standards, and Closehouse were out; Charles Wensley had forfeited his lease at Level Head Lunehead in 1748; George Bowes partnership mine with Lord Carlisle at Crinkled How was unproductive; and Green Mines, then in George Bowes' hands, had become inactive, mainly because of severe weather, although he planned to bring in more labour for further trials in the Spring.[607] Revival was in the offing, and from 1752 when Bowes appears to have had another brief affair with Isabell mea Hill, interest from adventurers was rejuvenated. Charles Wensley returned to Lunehead to mine at Rowton Sike in 1752, the at the Old Field at Lunehead in1754, to be partnered in 1755 at Rowton Sike by Bowes. The other indigenous veteran Jonathan Watson began hushing at Closehouse in 1755. In addition, a local three man partnership – Tim Bainbridge, John Bainbridge, and William Tarn - began working Isabell-mea-Hill.

It was during the 1750s that interest and finance became more regional and less local, and inter-regional. In 1754 Samuel Bacon, perhaps a member of the

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[606] The 'Gate' was abbreviation for Billingsgate. Henry Liddell, the coal magnate used it when writing about coal dealers in 1710. See R. Smith, *Sea Coal to London* (London 1961) p. 40 and p. 83. Also Hughes, *North Country*, quotes the same source pp.178-181.

[607] *D/St/C2/1/5 (4)* a memorandum from Thomas Colpitts I to George Bowes 15th February 1750.

family who partnered the Blacketts, was granted a one year tack with an option for twenty-one years at Standards, and in 1755 Thomas Pierse of Piersburgh in Yorkshire was granted the same form of lease for an area of Mickle fell including Nichol Hopple Yard. Green Mines and connected workings, including Longstaff Hush, was taken by five partners in 1755 under a twenty-one year lease; William Dockwray, gentleman, from Backbarrow in Lancashire - a location for iron production; Joseph Cradock of Denton , Newcastle, a clerk; William Watson, gentleman, of Dikehouse near Hartlepool; John Cradock, a Barnard Castle merchant; and Anthony Cradock, gentleman, of Barnard Castle. Lastly, in 1756 a twenty-one year lease was granted by George Bowes to George Tissington of Winster in Derbyshire, and his unnamed partners. Tissington was a member of the Derbyshire mining family and the lease for all lead and copper covered a broad area of Mickle Fell, including Nichol Hopple Yard and White Pitts on Noon Hill, Black Sike, and the assignment of Bowes lease at Silverkellwell.

The evident change in regional and inter-regional sources of partnership and venture capital during the 1750s can hardly be termed a rush for grey gold, but the Bowes estate had become recognised for its potential mineral wealth. Nevertheless, it marks the beginning of a gradual transformation in the structure of the lead production business on the Bowes estate that was to occur after George Bowes died in 1760. Once initial shallow workings were exhausted at low cost, the development of lead extraction had as a prerequisite the availability of risk capital to invest in improved technology for deeper mining in the medium to longer term. The Bowes family adopted a low risk stance in the later eighteenth century. This did not happen immediately after 1760; instead there was an intervening decade of reassessment and reorganisation.

George Bowes contributed directly to the management of labour in lead production. He was anxious to maximise man-hours, avoid loss, and reduce costs in the use of timber, stocks of which were expensive in mining and the main form of capital formation underground. He instructed that miners and smelt mill workers were motivated by being paid regularly in order to maintain output and to prevent them from becoming distracted by other sources of income:

> 'Lunehead to be pushed on and more men set to work.
>
> The Mill expenses to be paid every six weeks. Leadings of oar as well as lead ditto.
>
> The wood made use of in very shaft & to be noted in ye Bargain Book & compared
>
> monthly with ye stock.
>
> Weekly presentns. To be sent to Gibside every week both from Mine & Mill receipts'.[608]

In October 1756 rationalisation took the form of incentives, because instead of making payments as slowly as possible, a memorandum instructed faster payments for all those involved in the process of lead production:

> 'The carriage of Lead Ore to be pd. Weekly.
>
> The hushers at Isabel Miah Hill to be paid Im-
>
> -mediately 60s on Condition that they give up their
>
> Bargains at Christmas and then to be paid clear
>
> Off for all the Ore left
>
> The Ore Carriers to be paid for the pasture every Month.
>
> The Fathom and Sinking to be paid every Month

[608] *D/St/B2/91(3)* c.1740-42

The Ore Washer to be pd. every half year

The house and stables to be instantly Repair'd

Nathan says the level in Isable miah hill to

where the Ore was last may be carry'd up for 30s' [609]

Bowes' assessment of the lead production process by the mid-1750's had changed. The latter section of his memorandum of 16th October 1756 reveals a remarkably different stance in his attitude towards the various parts of the production process. The hushers were to be paid to get on with the task, but then made redundant, because Bowes, based on Horn's opinion, believed their efforts were at the margin and did not wish to waste money. He also decided to encourage the carriers, the men who owned the packhorses, which carried the ore and smelted lead from mine to mill to market. He even thought capital spent on a house for miners and stables was worthwhile. At Isabell-mea-Hill Bowes considered increasing performance pay for miners as an incentive to get the ore Nathan Horn believed was there. Thus, George Bowes injected lead mining in Upper Teesdale with an urgency not seen since the 1740s.

He paid equally close attention to the preparation of ore for smelting, because he knew this not only aided the smelter, but could enhance the quality and yield of pig lead - 'Great care to be taken in ye washing of ye Oar'.[610]. George Bowes directed that 'Nath (an) to be ordered to look very particularly to ye well washing of ye oar & such as is not well washed to have it washed over again, and to take care for ye future ye wasters have ….wages allowed.' [611]

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[609] *D/St/B2/93* the spelling in this transcription is that of Richard Stephenson not George Bowes. Unfortunately, his original memorandum of 1756 is not in the Strathmore Collection.

[610] *D/St/B2/135*, 'Some Memds relating to ye building of a Smelt Mill'.

George Bowes did not introduce technological change in the smelting stage of the production process, but was responsible for managing the primary input - the smelter's skill - and therefore the efficiency of metallurgy and ultimately its productivity. He was aware that lead smelting was a craft, and that the skill of experienced smelters was fundamental to the manufacture of quality pig lead. The art of smelting lay in the smelter's ability to combine ore and fuel at different temperatures at various stages whilst applying an evenly distributed blast of air over the hearth. Early in June 1741 he made such a visit to Bollihope smelt mill where he had 'directed' the smelters to try smelting twenty bing of ore before fixing a rate of pay for the 400 bing thought to be at Isabell-mea-Hill.[612] This canny approach is noted in a letter from Thomas Colpitts I to Bowes at Gibside in which Colpitts confirms his agreement to do this, and also mentions their meeting about fuel requirements and the carrying of peat and ore. To obtain the optimum amount of pig lead smelted he attempted to hire the best smelters. Thomas Moses was a smelter for the Vane family, and Bowes intended to set him on at Bollihope and wrote 'Thomas Moses late a Smelter to Mr.Vane came to offer his services to me, Q Mr Vane about this character and discharge'.[613] Bowes also noted that Moses informed him that Vane had paid him 5s 6d per fother smelted and that there is 'a great deal of art in building hearths which he always built at Mr. Vanes'. Bowes interest in employing Moses stemmed from James Sanderson, the leading smelter at Bowes' mill in the 1740s, who had commented that Moses could smelt twenty-five bing of ore per week, and that he would like him as an assistant smelter. He also noted that he would be interested in Lane Sanderson as a smelter, because 'Lane Sanderson used to Smelt ore for Mr.

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611 *D/St/B2/91(3*) a George Bowes' memorandum, dated by archivist at c.1740, but probably 1742.
612 *D/St/C1/3/60 (1)* Letter from Thomas Colpitts I to George Bowes dated 18th June 1741.
613 *D/St/B2/135* Bowes memoranda on smelt mills

Bacon at 6s per fother'. Consequently, Bowes ordered Thomas Colpitts I to open negotiations with Thomas Moses.

George Bowes improved the disciplined work rate of his smelters, which proved efficacious for both the use of materials and output. This managed change in smelting skill on the Bowes estate can be identified by analysis of the ratio of smelter's pay to total smelting costs, because there is a strong correlation during the 1740s between the level of smelting activity in terms of the amount of lead smelted, and the proportion of smelting expenses - including pay and related expenses, such as materials – consisting of the smelter's pay.

Broadly, the costs for smelting in Table 19 below correspond to the amounts of pig lead smelted. During the 1740s a smelter was paid 5s 6d per fother of lead smelted, where each pig or piece was on average between 11 and 11½ stones, with 16 pigs or pieces to a Newcastle fother of 21 cwt.[614] In the years 1757-59 a smelter was paid 7s per fother of lead.[615] It is worth noting here that in 1757 the smelter John Langstaff earned £12 whereas the mill manager, Gibson, received £10 salary. In 1742, a year of relatively high production, when the smelter's pay rate was

Table 19

Expenditure on smelting1741-46 and 1757-60

[614] The smelter's pay is confirmed in the accounts *D/St/B2/105*, and cross-referenced in an agent's notebook *D/St/E3/5/21*. The weights are also noted in *D/St/B2/105* accounts documents.

[615] This rate of pay is confirmed in the Wemmergill Smelt Mill pay bills, *D/St/B2/126 &127*.

Year	£	s	d
1741	50	18	2 ¼
1742	36	12	11
1743	49	9	8 ¼
1744	28	10	2
1745	24	0	¾
1746	10	8	10 ¾
1747- 1756		no data	
1757	115	14	0
1758	123	11	0
1759			
1760	24	9	11
TOTAL	466	10	10

Source:
For 1741 *D/St/B2/103*; for 1742-46 inclusive *D/St/B2/105*; for 1757 *D/St/B2/122*; for 1758-60 from *D/B2/St/127*. The figures from *D/St/B2/105* include materials as well as actual smelting costs, as noted in the original document. The figure for 1760 is for the period 1st January 1759 to 22nd January 1760.

5s 6d per fother, the total cost per fother of lead smelted was 7s. 9 ¼d. In other words, the pay was 70.71% of the cost per fother smelted. Again, in 1743 it was 58.26% of the smelting cost per fother of 9s 5 ¼d. In 1744, when the amount of lead smelted fell by almost 79% from the previous year, pay was only 21.41% of the smelting cost per fother of £1 5s 8 ¼d. The 304% increase in lead smelted in 1745 from 1744, saw the smelter's pay rising to 82.46% of the smelting cost per fother, when the smelting cost per fother was 6s 8 ½d.[616] Perhaps this is an indication of the smelter's skill and efficient use of materials in times of greater production.

The same analysis can be applied to the late 1750s, but with appropriate adjustments to the financial information available, because the accounting system changed after George Bowes built the mill at Wemmergill. From 1757

[616] These calculations are based upon accounting information in *D/St/B2/105*, and should be considered a good estimates of the cost structure of smelting where the total expense of smelting lead consisted of smelters' pay at the given rate per fother and the provision of materials needed in the smelting process, and including such items as repairs and general labour.

Wemmergill smelt mill became the hub of Bowes mining activity, essentially because of its proximity to his mines. There were two consequences: firstly, the carriage of both ore and smelted lead altered, because the transportation of ore was over shorter distances, but pig lead over longer distances; and secondly, the management accounting practice of John Gibson, the smelt mill manager changed to include the cost of ore carriage from the nearby mines and lead carriage to Wolsingham, but not beyond there. So, in the last quarter of 1757 when a smelter's pay rate was 7s per fother, it made up 61.7% of the smelting cost, as defined for the 1740s, when the total cost of smelting per fother of lead was 11s 7 ¼d. In 1758, the proportion was 61.71% of the total smelting cost of 11s 4d, but in 1759/60, a year of very low output, only 9.12%. Again, the correlation between the amount of lead smelted and the ratio of smelter's pay to total smelting cost is demonstrated in the late 1750s – high output of pig lead is matched with a higher and consistent proportion of pay to other variable costs, such as fuel, general labour, and other materials required for smelting.[617]

The yield of pig lead from ore in the smelting process was a focal point for George Bowes' micro-management, which led to the improvement in productivity discussed above in chapter 6. In the early 1740s Bowes noted his reckoning that 'If 4 Bing makes a NewC foder of 21Ct 32oz of Oar produce 21oz of Lead'.[618] The application of his knowledge of smelting is further confirmed by Bowes'

notes in a document entitled 'A Computation maid for a Lead Mill at ye Mine', which concluded that it would be cheaper to smelt slags at a mill built at Spurls Wood than at a mill built near the mines.[619] The value of smelting slags to obtain a greater yield of pig lead from ore was a serious issue for Bowes, and after reading a steward's

[617] These calculations are based upon financial information derived from *D/St/B2/ 126 &127* smelt mill paybills. Again, these should be considered as good estimates of the nature of smelting costs.
[618] *D/St/B2/135* Bowes calculation was correct, and equates to a ratio of 1.5:1 ore to pig lead.
[619] *D/St/B2/135* smelt mill memoranda.

report on yield from various mines, he wrote on it 'To give orders about the picking of lead out of ye slags, a Fother of Lead yields 10 stone out of ye slags unpicked, if picked only 5 stone'.[620] On the same document noted adjacent to figures for yield of ore bought from the Dodd Hill lead mine 'Q why this oar is not refined, if any was sent to ye mills', because there was no record of it being carried to the mill or being smelted but the yield of pig lead from it was reported as better than from the other mines recorded therein.

Smelting was the final stage in the production process, and the skill involved was valuable and essential to its profitable marketing. The smelting process as a variable cost was obviously more manageable and controllable, because it was a direct function of the amount of ore mined and dressed. Expenditure on smelting was a much lower level of risk capital than mining, but carriage costs could erode profit subject to current market prices at Newcastle.

Carriage costs were as much a determinant of the viability of lead mining on the Bowes estate as anywhere else, because the cost of actual extraction was beyond the control of both Bowes and his lessees, especially where mining became deeper.[621] There was no road infrastructure and no navigable river system to facilitate the carriage of lead ore and pig lead. Consequently, both these commodities were carried overland by packhorse. George Bowes was preoccupied with the carriage costs, and particularly those for ore, because it was bulkier. Carriage was the most important variable cost in the lead industry; controlling it and reducing it wherever possible could make a significant difference to profit, and consequently lead mining viability. Bowes shrewdly gleaned knowledge from other producers in the

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620 *D/St/B2/155* the produce of mines in 1741.
621 See Burt, *British Lead*, pp-207-212.

region. For example, in 1742 he noted a comment regarding ore delivery to Bollihope smelt mill from a smelter working for the Vane family, mineral lords north of the River Tees; 'Elliot says that on a calculation at Raby it was found ye about 8s per fother might be saved by building a mill at ye Myne rather than at their present mill'.[622]

In the same way he headhunted the best smelters, George Bowes sought carriers capable of speedier pack-horse carriage, therefore cost reduction, in delivering from Bollihope smelt mill to Shield Row. He instructed Colpitts to fix an agreement with one Ralph Palmesley who had developed a reputation carrying pig lead for Mr. Bacon in Allendale, because Bowes knew that the rate per mile paid by Vane family was less than his.[623] The costs of carriage were determined by the market

price of pig lead and distance, and particularly the distance ore was carried from mines to the smelt mill, because it was bulkier than pig lead. Conversely, the closer the smelt mill was to the lead mines meant pig lead was carried over a greater distance than ore, thereby reducing the overall cost or carriage in the progress from mine to market.

After the discovery of Isabell-meah-Hill in 1740 and the initial spurt in lead production, George Bowes was confronted with two dilemmas; the carriage routes and distances involved for both ore and pig lead, and the location of his smelt mills and proximity to the mines. Both were determinants of carriage costs and therefore profit. The fuel for smelting, peat, was readily available in Upper Teesdale and easily and cheaply cut and delivered by cart to Bowes mill wherever they may be. The lead business records give the impression that George Bowes dealt with the two

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[622] *D/St/B2/155* accounts of ore delivered to and smelted at Bollihope Mill 1741-42.
[623] *D/St/B2/91* a Bowes memorandum in his hand.

dilemmas simultaneously.[624] There were various proposed locations existed for smelt mills, and there were two possible carriage routes available for pig lead smelted at Bollihope; north to the River Tyne and the port of Newcastle, or east to Stockton, which may appear the more obvious choice. The latter was a major consideration for George Bowes once Isabell-mea-hill was in production.

After lengthy consideration he made the key decision that, rather than distribute lead from his estate to to Stockton, it would go to Newcastle via the River Tyne. How did he assess and decide upon a route? Bowes instructed his agents to measure and compare distances for a way north to Newcastle - from Isabell-mea-Hill mines to Bollihope, Bollihope to Wolsingham, thence to Blaydon or Swalwell on the Tyne – and a way east to Stockton – from the mines to Middleton-in Teesdale, there to Staindrop the road from where leads to Stockton, with Streatlam implied as a staging post only a few miles southwest of Staindrop. [625] Bowes described variations in northerly and easterly carriage routes, one including the 'use of Vane's Mill' then onward to Raby. [626] George Bowes focused on pig lead carriage costs and concluded that taking the northern route was cheaper, smelting at Bollihope, and then use the coal waggonway to the River Tyne. George Bowes noted that '3 Fother of Lead may be conveyd to my staiths for 2s 6d……and will save ye expense of Agents going to Stockton and Agents there'[627] Consequently, from no later than 1742 he employed the waggonway for the final stage of pig lead transportation to his staith at Dunston on the Tyne. In addition, Bowes avoided the costs of agency at Stockton, which in turn avoided further eroding his margin. There is no evidence at any point of pig lead

[624] *D/St/B2/135* containing memoranda, costs estimates, and plans for smelt mills.
[625] *D/St/B2/135 (12 and 13)* cost computations for smelt mills, dated at 1742 and later.
[626] Bowes does not state which mill, but references to 'Vane's mill' and Raby (Castle) would suggest he meant Eggleston Mill.
[627] *D/St/B2/135* Bowes memoranda.

carried to Stockton, regardless of its appearance as the natural market choice.

George Bowes' initial decision then, was to continue moving ore to Bollihope rather than hiring other smelt mills, such as the mill at Eggleston used by the Vane family, and then pig lead to the River Tyne with the last stage by waggonway. This decision organised four stages of transportation in the lead production process; the journey for ore from the mines in Upper Teesdale to Bollihope, which was broken into two sub-stages, namely 'Teesdale carriage' and 'Weardale carriage'; pig lead from Bollihope mill to Wolsingham; pig lead from Wolsingham to Shield Row; and pig lead from Shield Row to the staith on the River Tyne.[628]

Smelt mill location was the other element of the organisational problem. Plans and estimates for the building of smelt mills were drawn up for George Bowes during the early 1740s, and these together with his own memoranda relating to distances and possible sites for mills, evidence his business plan for the reorganisation of lead production including the reduction of carriage costs. The relocation of smelting at Wemmergill was put in abeyance until 1756, some fourteen years after Bowes became concerned about the structure of the lead industry on his estate. The building of a new mill at Wemmergill in close proximity to the mines changed the stages of transportation after 1757 when it began to receive all the lead ore from the Bowes estate. The ore was carried a much shorter distance, but the smelted lead a longer distance from Wemmergill to Wolsingham, Wolsingham to Tanfield, and from Tanfield to the staith.[629] In other words there were still four stages in the carriage process, but by far the shorter part was ore carriage, always the most difficult and most expensive by weight and distance.

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[628] *D/St/B2/103* report of carriage and *D/St/B2/125* pay bill for ore carriage to Bollihope mill.
[629] *D/St/B2/150 and D/St/B2/127*, accounts of pig lead carriage costs.

George Bowes personally considered the two aspects of lead smelting: mill location in terms of operation – power, fuel and roads; and the possibility of expanding smelting as a business activity. During the 1740s he gathered plans and costs for smelt mills both on his estate and nearby. Staindrop, Holwick, Mickleton and Spurls Wood were all perceived as possible sites in relation to water-power, peat and coal for fuel. The details of these plans have been discussed above.[630] Perhaps the key document in Bowes' decision to relocate the smelt mill as part of his reorganisation is 'The Difference between smelting at Boylup and building a New Mill at Isabell-meah-Hill'. This shows that the overall cost of smelting 600 bing of ore, would be thirty-five percent cheaper, £59 8s 4d. The main saving was on carriage costs. In other words, Bowes realised almost at outset that reorganisation of the whole production process hinged on the relationship between location and carriage.

Table 20 below demonstrates the effects of George Bowes' decision-making in managing carriage costs during the 1740s and relocating smelting in the late 1750s. Almost all carriage costs for lead ore were for transportation from Isabell-Meah-Hill to the Bollihope smelt mill, because the amount of ore other mines included in these figures was relatively small.[631] During the years 1740-46 the cost of ore carriage significantly outweighed that for smelted lead, and discrete year analysis shows that only in 1743 and 1745 was the latter greater than the former. The cost of ore carriage during the 1740s was generally higher than the cost of carrying pig lead because the journey distance was greater. It was during the 1740s that Bollihope smelt mill received all ore from the Bowes estate and any bought in ore. Apart from 1751,

Table 20

630 *D/St/B2/135* documents relating to smelt mills.
631 See Table I of the appendices showing ore production from the various mines during the 1740's.

Costs of carriage for lead ore and smelted lead 1741-46,1751, &1757-60

	Lead ore			Smelted lead			Total		
	£	s	d	£	s	d	£	s	d
1741	125	10	3	35	12	6	161	2	9
1742	111	8	0	64	14	6	176	2	6
1743	68	13	0	81	8	0	150	1	0
1744	47	7	0	25	14	8 ½	73	1	8½
1745	25	19	0	36	14	6	62	13	6
1746	16	1	0	2	11	8	18	12	8
1751	No data found			22	8	1	22	8	1
1757	5	8	6	31	7	0	36	15	6
1758	39	13	1 ½	88	19	5	128	12	6 ½
1759	8	16	3	14	3	10	23	0	1
1760	3	9	9	1	0	8 ½	4	10	5 ½

Source:
Derived largely from *D/St/B2/105 (9)*, a ledger of miscellaneous receipts for expenditure at Isabell-mea-Hill, Arngill, and Standards mines, and including the carriage cost of bought-in ore from Dodd Hill. The figure for 1751 is from *D/St/B2/109*, an account of receipts and expenditure for all mines. For 1757-60 *D/St/B2/126-127* smelt mill pay bills.

no records of pig lead carriage were uncovered for the period 1750-56, probably because ore production was relatively insignificant. The effect of building a mill at Wemmergill closer to the mines is blatantly obvious for both types of carriage from 1757 to 1760. It is quite clear that the cost of carrying a bing of ore fell by a half when the 1740s are compared with the late 1750s; this was the desired Wemmergill effect. [632] The average cost per bing of ore during the 1740s was 4-5s,but for the period

1757-60 it was 2-3s.

Did Bowes achieve a worthwhile reduction in the cost of pig lead

[632] *D/St/B2/125* accounts for the lead mines and D/St/B2/127 smelt mill paybills.

carriage to the River Tyne from Wemmergill in the period 1757-60 compared to the 1740s? This analysis is somewhat more difficult because pig lead carriage costs are sparsely documented compared to those for ore in the 1740s. The cost of lead carriage from Shield Row to the Tyne was recorded by Francis O'Neale in 1742 as 2s 6d per fother 'Shield Row to the staith per waggon'.[633] Indeed, the waggonway was in use no later than 1742, and made pig lead carriage much easier.[634] For the period 1757-60, however, there is sufficient accounting for pig lead carriage costs.

In 1741 pig lead carriage cost from Bollihope to Shield Row via Wolsingham was 11s 10 ½ d.[635] In 1742, the cost was11s 4d; in 1743 15s 1d, but less at 10s 2d in 1745.[636] The cost of the journey from Shield Row to the staith is largely unknown for the 1740s, except for 1742. In 1757 lead carriage from Wemmergill via Wolsingham to Tanfield Moor was 18s 4d, but the cost from Tanfield to the staith is unknown.[637] This journey cost 17s 6d 1758, and the stage between Tanfield and the staith ranged between 11d and 1s 4d per fother.[638] In 1759 Wemmergill to Tanfield cost £1.[639] The cost per fother in 1760 for the Tanfield to the staith stage rose to 1s 10d.[640] The much lower cost per fother on the final leg must be attributed to the use of the waggonway that served the Bowes coal trade, but the absence of lead carriage costs for the 1740s from Shield Row dictates that for the purpose of this exercise we must either ignore the last stage of carriage to the staith, or assume the carriage cost at this stage was either the same or of insignificance in the overall cost mechanism.

George Bowes' assessment of the impact on potential pig lead profits

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633 *D/St/E3/5/21* Francis O'Neale's account book for 1742.
634 The waggonway was used for coal transportation from 1728.
635 *D/St/B2/103* Mr. Leaton's account book for Isabell-mea-Hill and other mines.
636 *D/St/B2/105* accounts for the lead business 1741-49, and *D/St./E3/5/21* Francis O'Neale's accounts for the Wemmergill estate.
637 *D/St/B2/126 &150* accounts for lead delivered.
638 *D/St/B2/127* pay bill for Wemmergill smelt mill.
639 *Ibid.*
640 *D/St/B2/150* accounts for lead delivered.

in Newcastle of reducing total carriage costs proved correct. By adopting the three contemporary calculations of the yield of lead from ore it is possible to compare the total carriage costs of one fother of lead. In 1741 Thomas Colpitts calculated that 4.83 bing of ore produced one fother of lead (the author has adjusted this to 4.94 after checking the Colpitt's calculation); in 1743 Richard Stephenson reckoned it was 4.7428 bing; and in 1757/58 Stephenson says 4.44 bing made one fother of pig lead. John Gibson, the Wemmergill smelt mill manager in his report on the smelt mill production, calculated that 4.28 bing produced one fother of lead in 1758.[641]

Therefore, in 1741 the total carriage cost for ore and lead from the mines to Shield Row was £1 15s 1 ¾ d, and in 1743 a 3.13% fall to £1 14s ½ d. George Bowes had not at this early stage, however, introduced changes to the structure of carriage. After the opening of Wemmergill and the closure of Bollihope the ratio of carriage costs changed. The total cost of getting one fother of lead to Tanfield in 1757 using Stephenson's figure was £1 11s 8d, and for 1758 £1 10s 10d. Taking Gibson's figure the total cost in 1758 was £1 10s 4 ¾ d. Consequently, it should be concluded that the change in carriage costs was due to a 25% drop in ore carriage per bing, from 5s to 4s, and a 20.83% drop in lead carriage per fother as a direct consequence of a change in the market price of lead. The analysis of market prices below certainly proves variability of pig lead prices in 1743 of up to 8.5% lower and 14.89% higher than in 1741, with Bowes agents estimating stock values in 1743 at 9.8% lower.

In 1757 when Wemmergill began smelting and ore carriage became considerably cheaper, the total carriage cost to produce one fother of lead and deliver it to Tanfield was 9.9% lower than s the base year 1741. The 1758 total carriage cost

[641] *D/St/B2/154* Colpitt's memorandum; *D/B2/157* Stephenson's memorandum; and *D/St/C/3/77* Gibson's report to Stephenson.

was 12.27% less than in 1741 when Stephenson's yield estimate is used for ore, and when Gibson's is used it is 13.5% less. Clearly, whichever ore to lead ratio is used, George Bowes' assessment of the effect on total carriage cost, and therefore potential profit, of the ore cost element along the established routes was correct. The cost of ore carriage during the 1740s appears to have been insurmountable; it was determined by the market and beyond the control of George Bowes. His decision to build a mill nearer the orefield brought about a worthwhile lowering of ore carriage costs, which had a potential impact on the profit of pig lead in Newcastle. In 1741 the 960 pieces of lead delivered to Shield Row would have cost Bowes £105 8s 9d. The same amount in 1743 would have cost £102 2s 6d. In 1757, however, the cost would have been £95; and in 1758 £92 10s using Stephenson's figures, or £91 3s 9d using Gibson's figures. This is equivalent to a 12.89% reduction in carriage cost to the point where the pig lead was led to the staith on the waggonway.

George Bowes' experience of the lead business in the 1740s taught him that controlling and reducing this particular variable cost would enhance profit. Although he did not succeed in achieving lower carriage costs in the 1740s, his belief in 1756 that the market for lead was changing brought capital investment in the form of Wemmergill smelt mill, which meant the character of carriage changed to shorter journeys for ore and longer for pig lead, which in turn reduced carriage costs. George Bowes changed the lead business model following his diagnosis of its performance of the 1740s. The outcome by the late 1750s was that ore carriage costs were slashed, and pig lead carriage costs were significantly reduced, and consequently Bowes was supplying lead more competitively.

The relationship between movements in the market price of pig lead

and restrictions on trade are stated above. Lead production was affected either negatively or positively according to pig lead prices, and in this context the Bowes estate must be seen as a microcosm of an industry-wide characteristic of abrupt changes in lead mining output. How did George Bowes manage this market-driven phenomenon?

Bowes appears to have expanded mining output, primarily from Isabell-mea-Hill, in the early 1740s in response to war demand and steady or slightly rising prices in the brief period 1739-42. Pig lead sale prices did not exhibit sudden downward movement thereafter, but a slight rise in 1748, the last year of war. Bowes did not hurriedly increase output at this point, probably because he was holding stocks of pig lead from early years. When prices began to rise from 1752, again Bowes did not drive up lead production. Indeed, he only reopened Isabell-mea-Hill, by then renamed Birkdale, in 1758 after prices had peaked.[642] Correspondingly, smelting ceased at Bollihope and the evidence suggests that it passed into the hands of Samuel Bacon from 1750/51. Horne was also instructed with his colleague, Francis O'Neal, 'to wait on Mr. Bacon when he comes into ye County & desire to know what he charges for ye use of Bolliop Mill. Nathan says she is not worth above £4 per annum'. Ore from the Bowes estate was sold to Eggleston Mill in the early 1750s, an Bowes did not become directly involved again in smelting until Wemmergill mill was completed in 1757.

George Bowes reacted to positive price change or market equilibrium by mobilising resources in order to increase output. Obviously, a period of time elapsed before lead mining output could react, but he seems to have accomplished this in the early 1740s at the mines he worked, especially Isabell-meah-Hill. This feat of

[642] See Table 14 Chapter 7 above, and 1730s prices in Hughes, 'Lead Land and Coal' (unpublished PhD thesis) Appendix Table 13.

expediency in the wilderness of Upper Teesdale involved attracting more labour and possibly paying more, which we have seen was a function of market price. The features of this managed process of change in a rural frontier economy are evidence of Bowes as a capitalist. He knew that, because of the nature of mineralisation, lead mining was centralised; that it was possible to expand existing workings or re-open older ones; that more labour, or paying more, would not involve a huge injection of capital; and that an increase in production could be achieved in the very short term. Working capital was expended on paying miners who were in effect self-employed; their incentive was a rate per fathom – fathomtale- for deadwork by the fathom i.e. not winning ore, or a rate per bing of ore extracted – bingtale. Both rates were a reflection of how difficult the task would be. Paying miners a guaranteed wage was not an incentive for miners to achieve the owner's objective, and man-management would have been almost impossible.[643] Bowes, through his stewards, made these bargains, and generally supplied tools and equipment. At Cronkley in 1741 tools were valued at £29 10s, and at Lunehead £10 1s 8d. As well as tools, Bowes invested £82 2s 0d for the building of a house in 1742 for miners to lodge in at Isabell-meah-Hill.[644] 'The house to be built with all expedition' referring to the need for accommodation at Isabell-mea-Hill.[645] In other words, there was no prerequisite for enormous capital outlay, but the arrangements for tools, equipment, and mining expertise encouraged and supported small-scale enterprise.

The Bowes response to negative price change from 1758 was to promote the continuation of exploration and mining by granting tacks and leases for duty ore, and, with the exception of Birkdale, refraining from working his own

[643] All mines paybill records D/*St/B2/116-122* and other financial statements show these two forms of payment. Wages were rarely paid, usually only for a day's work when extra labour was needed.
[644] *D/St/B2/101, 105, and 134.*
[645] *D/St/B2/91(3)* a George Bowes handwritten memorandum of c.1740

mines on the estate. The letting of mines removed risk in a poor market, but the option remained for revisiting these mines at a later date when viability and risk became acceptable in the knowledge that workings were not long dormant. Regardless of the type of strategy adopted to meet market conditions, close management by George Bowes and his stewards was essential; optimisation of labour, both in leased and Bowes own mines, was based upon control.

George Bowes was an important figure in he Newcastle lead trade, but he also played a significant contributory role in London that affected both lead production on the Bowes estate and trading relationships in the northeast. His direct involvement ranged from management on the estate to face-to-face negotiations in the capital. In this way Bowes lubricated the mechanism of regional trade which ultimately supplied the London market and ultimately foreign markets.

Bowes directed the trade in ore and pig lead, especially during1740s. He ordered stewards and agents in the field to act as buyers of ore. Aware of lead mining in Weardale, the location of his mill at Bollihope, in the early 1740s Bowes established this role by instructing Horn 'to look at oar near Bollihope & to buy it if to be had at a reasonable Rate'.[646] Later, in 1758, Bowes via Richard Stephenson, offered to buy Jonathan Watson's ore at between 42s and 45s subject to the price per ton of pig lead 'at Market', and that Horn would be the buyer'.[647]

In the 1740s George Bowes appears to have acted as merchant in Newcastle, and probably London. The lead business records place him in Newcastle during the summer months when he was resident at Gibside. He frequented Thomas

[646] *D/St/B2/91* memoranda concerning lead pay, ore profits, and smelt mills. Undated, but probably c.1741/42

[647] *D/St/C2/3/75* Stephenson to Watson 20th August 1758.

Swifts in Pipe(r)gate where he received regular reports from James Sanderson, as to pig lead production leading smelter at Bollihope. Bowes was keen to sell his pig lead quickly in Newcastle, and summer and early autumn was the time to do it, when sailings to London where frequent and roads from Upper Teesdale were passable. Bowes gathered detailed reports from Bollihope that addressed all aspects of the production process, which allowed him to compile a cumulative total of pg lead produced. Not only did he maintain cumulative totals of lead output, he wrote sub-totals for each mine.[648] The importance of Isabell-Meah-Mill to Bowes trading profits is higlighted in James Sanderson's letter to George Bowes of 1st August 1743 addressed to Bowes at "Thos. Swifts, in Piper Gate, Newcastle-upon-Tyne', confirming that twelve fother of lead had been made, that there was more than twenty-four bing of ore from this mine at the smelt mill, and "that we have Delivered Eight hundred and Seventy two Pecs of Lead from the Mill this account which Makes

fifty four fudor And Eight Pecs of Lead".[649] Similarly, Nathan Horn's account of 1746

itemises 96 bing of ore and 15 bing of duty ore delivered to Acton Mill, owned by the London Lead Company, from Lunehead, Standards, and Arngill mines.[650] George Bowes was eager to get lead to market, consequently detailed accounts of progress and estimates of production at different stages in the process facilitated his understanding of the industry and allowed him to gauge the return he could expect on his investment.

Bowes often conducted lead business in London where he interacted

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[648] *D/St/B2/155* Accounts of ore delivered 1741

[649] *D/St/C1/3/59* a letter from James Sanderson to George Bowes giving an account of production at Isabell-Meah-Hill dated 1st August 1743.

[650] *D/St/B2/81,* Account of ore delivered to Acton Mill 1746.

with members of the aristocracy and gentry who were also mineral lords or investors in lead mining. The earlier examination of the Bowes management framework for lead shows that stewards and agents employed in the lead industry reported to George Bowes both when he was in the North, and in London, not necessarily through the interface of a senior steward at Gibside or Streatlam. The London entrepot was the primary outlet for lead, Newcastle was one of its main feeder ports, and consequently Bowes' role in the capital was significant both in terms of lead sales and finance.

The joint venture lead mine at Crinkle How, where Bowes was in partnership with Lord Carlisle, was handled by Bowes in London when it became problematic. Consequent upon Colpitt's cessation of work, Carlisle owed Bowes a share of the costs.[651] Early in 1750, in reply to Colpitt's letter to him at his address in Hanover Square, London, Bowes confirmed that he met Lord Carlisle to discuss the state of the mine and instructed Colpitts to meet Cleaver, doubtless instructed by Lord Carlisle, 'on the spot' to resolve the matter and inform 'the principals' to enable them 'to settle that Business in some more certain way than hitherto we have been able to effect'.[652] This gives the impression that George Bowes preferred face-to-face negotiation, leaving his stewards to carry out instructions and finalise matters. In contrast, the Earl of Carlisle was prone to leaving his agents to deal with his estates.[653] The contretemps between the Bowes family and the Earl of Thanet over the lead mine lease at Silverkellwell remained unresolved long after the death of George Bowes, again somewhat hindered by Thanet's reliance on stewards on his Westmoreland estate.[654] Thanet, with others, owned lead mines in Eyam and Stony Middleton in Derbyshire for royalties during the first half of the eighteenth century, and

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651 *D/St/C2/1/5 (4)* copies of letters to George Bowes 15th February 1750, and to Mr. Cleaver at Castle Howard 9th March 1750.
652 *D/St/C2/1/5 (4)* extracted from Colpitt's letter of 9th March 1750 to Cleaver.
653 J.V. Beckett, *The Aristocracy of England 1660-1914* (Oxford 1986) p. 216.
654 *Ibid*. p.152

consequently did not need to have the same presence as Bowes, who both worked and leased lead mines.[655]

London was also the scene of lead-related financial transactions. George Bowes paid Sir Walter Blackett numerous amounts during the years 1749-56, although at this stage the precise reasons for the payments are unclear, because details are not recorded on the Child & Backwell bank statements[656]. The payments were as follows:

		£
May 3rd	1749	1,000
"		500
Feb 1st	1752	1,200
Mar 18th	1754	1,000
Jun 16th	1755	313
Mar 25th	1755	48 9s
Feb 20th	1756	500

Apart from these considerable sums of money, in May 1755 Bowes also paid £300 to C. Blackett, probably Christopher Blackett the Newcastle agent for Blackett lead sales. In addition, Bowes received £500 from 'the Lead Co.' in February 1756 and a further £24 in November that year. An initial suggestion is that this abbreviation most probably refers to the London Lead Company. Again, the nature of the transactions is unclear, but they are evidence of dealings in London between lead producers in the North, and George Bowes personal relationship with them.

Did George Bowes create a profit from the lead business on the family Estate? The value of smelted lead produced at Newcastle prices for the years when

Table 21

655 Burt, *British Lead*, p.30.
656 *D/St/C1/3/66* George Bowes' bank statements.

The value of lead produced at Newcastle market prices 1741-60

	Pieces of Smelted Lead	Value		
		£	s	d
1741	1666	1223	10	0
1742	1409	1045	15	0
1743	1663	1221	5	3
1744	355	255	3	1½
1745	1078	759	19	4½
1746	249	175	1	2
1747	589	414	17	8
1748	275	208	7	0
1749	56	42	0	0
Sub-total	7340	5345	18	7
1752		193	10	0
1757	700	672	13	1½
1758	1927	1625	18	1½
1759	13	12	9	2
1760	112	89	4	0
Sub-total	2752	2593	14	5
TOTAL	10092	7939	13	0

Source:
Generally, sixteen pieces of smelted lead made a fother. The value has been calculated per fother. Wherever possible Bowes prices were used from Table 14 above, and Blackett-Beaumont prices where there are no Bowes prices. An average price was used where data exists in ranges

output and prices are available is listed above in Table 21, though as already noted much of the smelted lead was not sold immediately. The total value was just under £7,940 for the years spanning 1741-60, of which sixty-seven per cent of this was produced during the 1740s. Market conditions and the effects of war on the lead business are discussed above.

Table 22 below shows estimated profits after deducting expenditure from sales, but should be viewed with caution, because expenditure on mining and

Table 22

Estimated profits from lead 1741-46, 1752, and 1757-58

	Sale value			Expenditure			Profit		
	£	s	d	£	s	d	£	s	d
1741	157	6	11	1197	11	7¼	(1040	4	8¼)
1742	384	0	9	747	4	0	(363	3	3)
1743	1732	19	8	557	5	7¾	1175	14	¼
1744	155	7	2½	412	9	9½	(257	2	7)
1745	47	18	0	312	6	6¼	(264	8	6¼)
1746	22	5	9½	197	17	11¾	(175	12	2¼)
1752	193	13	7	no full expenditure data					
1757	154	10	10	576	2	5	421	11	7
1758	8	8	9	657	6	3½	648	11	6½

Source: Tables 14-17

smelting in any given year does not necessarily mean the pig lead produced was sold in the same year. Lags in carriage and smelting, subject to market conditions, and the consequent delay in sales, were an inherent feature of lead production. Enforced stock holding in a market disrupted by wars has already been remarked upon, and to some extent Table 22 above is a guide to the risk to which the Bowes estate was exposed in the lead industry. The only trading profit was in 1743, and when considered on an aggregate basis, and assuming all lead produced was eventually sold at the prices used in valuing output in Table 22 above, then a possible profit over the years 1739-60 was £7,939 13s 0d less expenditure of £6,193 4s 1¾d i.e. £1,746 8s 10¼ d or the equivalent of a twenty-eight per cent return on capital over the long-term. Even the busy 1740s, a period of accelerating mining activity and smelting,

when taken in isolation appear to have been unprofitable. It is impossible to see the Bowes lead business as profitable before 1760, but there again the nature of mining should be taken into consideration.[657] The Bowes' financial position is in complete contrast to that of the Blackett-Beaumont business. During the period 1739-1760 their total profit amounted to £85,554 on sales of 374,667 pieces of pig lead, and a steady supplementary profit from the refining of silver.[658] The Blackett-Beaumont profit in 1741 from lead alone was £7,223.

George Bowes' management style was clearly not that of absentee landowner; it was autocratic in that he directed those in the management framework described earlier, but at the same time his judgments were based upon reported information and the views of stewards and lead industry specialists. He was assiduous in the assessment of his lead business; this was a feature of his behaviour from the discovery of Isabell-mea-Hill, and although more prevalent in the 1740s, the the impression is that it remained unchanged until the late 1750s. Bowes' hands-on approach embraced all aspects of the lead industry on his estate from exploration to smelting to trade, and was often circumspect in its nature. He was a strategist, and possibly more entrepreneurial in lead than coal, yet was also involved in the micro-management of lead production.

It is not the purpose of his thesis to examine George Bowes role in the coal trade, or to compare and contrast the extent of his management activity with his role in the lead business. Yet a cursory examination of a limited range of coal-related documents substantiates the argument that George Bowes played a personal,

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[657] The figure for expenditure does not include the cost of any bought in ore nor the counter-effect of ore sales. We have seen that at times ore sales were profitable, but could hardly have made a significant difference to lead profits on the Bowes estate.

[658] Hughes, 'Lead Land and Coal' (unpublished PhD thesis) Appendix Tables 11&17.

meaningful role in lead production on his estate and in the Newcastle and London market.[659] He did not retreat from coal affairs, even though the scale of the operation, membership of the Grand Allies, and the estate management structure for coal would evidently have facilitated an exit. George Bowes' continuous personal commitment to the coal business, by way of correspondence about collieries, shipping, staith building on the Tyne, the Billingsgate coal market, and monies received across three decades. He was in London for several months of the year, but his behaviour contradicts categorisation as the archetypal absentee landlord. Bowes was a chief Parliamentary protagonist for the coal interest, his bank – Childs & Backwell – was in London, and his connection within the network of aristocrats, gentry, and merchants was there. His apparent absenteeism was in fact very productive for the family estate, which included a direct role in the lead business too.

George Bowes was not unique in his desire to develop the mineral potential of his estate; gentry and aristocratic landowners with any wisdom understood the financial benefits of exploiting their estates.[660] The general view is that landowners adopted the easier, risk-averse stance by leasing mineral rights in return for royalties. In the North, highly valuable royalties were paid to the Denys family and the Earls of Pomfret for their mines in Swaledale, and the Duke of Devonshire for Grassington Moor.[661] This is not to say that they did not initiate some of their own operations, but Bowes appears different in that he leased mines, worked his own mines at times, and worked mines in partnership.

The extent of his involvement in partnership mines varied; George

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659 *D/St/C2/3/21/7; D/St/C13/34,36, & 39; D/St/C1/3/49,52,54, & 60; D/St/B1/2/28,99,101,116,146, & 170; D/ St/C1/3/39/2; D/St/C1/3/62.*

660 G. Mingay, *The Gentry: The Rise and Fall of a Ruling Class (London 1976)*, pp. 98-104; Mingay, *Landed Society*, pp.191-201; Burt, *British Lead*, pp. 26-32; Ward, *Land and Industry*, ch.2.

661 Ward, *Land and Industry*, p. 64; Burt, *British Lead*, p.32; Raistrick & Jennings, *History*, p. 263.

Bowes' assessment of risk and reward at any particular mine determined the partnership arrangements. The partnership with John Dent in1740 gave Bowes three-quarters; Dent's death in 1742 left Bowes with Isabell-meah-Hill, which remained in his hands apart from a few years in the early 1750s. He had a half share at Standards with John Langstaff & Co in 1737; a fifteen-sixteenths share at Lunehead in 1740-41 with Reverend Thorpe; five-eighths at Nichol Hopple in 1741-42; one-third at Black Sike in 1747-48 with his sister Elizabeth and her husband Edward Gilbert, and two miners; one-half at Crinkled How in 1749-50; and from 1751 four-fifths at Rowton Sike, Lunehead with Charles Wensley.

It is clear that George Bowes was personally involved in all stages of lead production on his estate; the lead industry was small scale compared to both coal and the activities of other lead producers in the North East and other areas, but Bowes was seriously committed to its development as a source of profit. He instigated change in the structure and organisation of production, and as such must be seen as an innovator. There is no evidence that diffusion of different technology or methods was part of this innovation; records of mining and smelting on the Bowes estate show that both were based upon muscle and skill assisted by waterpower and peat for fuel. In all aspects, increased activity was achieved within the bounds of existing knowledge and technology. Bowes was, however, innovative within the estate management system, because he introduced specialist stewards and managers purely for the benefit of lead production. He invested in excess of £5,000 in mining, carriage and smelting, almost three-quarters of which was on mining. Most of this expenditure was in the form of working capital, but he did build a new smelt mill at Wemmergill and a house for miners at Isabell-mea-Hill.

George Bowes introduced the bulk of working capital for mining,

smelting, and carriage, but only a small proportion of this was in partnership. His personal interest and financial commitment were greater in the 1740s, on the wane during the early 1750s, but around 1758 showed signs of reinvigoration. He did positively encourage the change away from small-scale regional sources of capital – merchants, miners, businessmen of various sorts, and professionals – to external sources, such as merchants and businessmen from Derbyshire and London.

The level of Bowes' working capital was miniscule compared to the nearby Blackett-Beaumont organisation, and although the Bowes estate encouraged and subsidised small-scale enterprise from within, there is little evidence of deliberate inchoation of extra-regional sources of finance. By 1760, other than perhaps at Isabell-mea-Hill, there was no deeper mining requiring larger scale investment. The very limited investment, particularly in mining, would indicate that following the initial euphoria of the 1740s George Bowes, leading the management structure, did not move lead production as an estate activity into the next stage of development characterised by deeper mining and a much greater capital funding over the medium to longer term. Lead production remained in a germinal condition by 1760, following almost thirty years of intermittent capital input which targeted the most accessible lead ore.

Notwithstanding his role and level of commitment to the continuation of exploration and mining activity on the estate, George Bowes did not invest in deeper mining, nor did he grant leases to the larger companies nearby – the Blacketts and the London Lead Company –who could have initiated larger scale extraction. There is no evidence of offers or proposals from either of these companies, and indeed Bowes himself had the financial capability to expand lead mining in Upper Teesdale. The analysis of different aspects of expenditure and the market for pig lead

during the period 1740 to 1760 give the impression that in response to positive market conditions Bowes was willing to invest more. Furthermore, although he behaved in patriarchal fashion towards the development of the family estate for purposes of continuity, his plans for lead did not go beyond the reorganisation of the production process and the financing of shallower mines and existing workings. He did, however, make progress in the re-shaping of the lead industry on the Bowes estate.

Oldroyd correctly refers to George Bowes a inheriting a system of estate 'practice, organisation, and accounting'.[662] He maintained a stable management structure in terms of both personnel and roles, and the system he inherited and developed survived his death in 1760. This will be examined below in Chapter 9. Oldroyd suggests that Bowes was a strategist and uninvolved in the day-to-day management of all aspects of the estate. The estate system and the specialists he introduced into lead production undoubtedly dealt with operations in the field, however this analysis demonstrates that George Bowes certainly did not leave them to their own devices. He may have delegated, but retained ultimate control through his insistence upon receiving regular management information and accounts. Moreover, he was an inveterate visitor to his various estates, and became engrossed in the lead business, especially in the 1740s. Regularity of written communication and visits show that to some extent he did inject himself into the field management of mining and smelting. Correspondence and his own reports and memoranda reveal a man with an in depth understanding of the different stages in the production process

George Bowes was innovative compared to his predecessors' approach to the lead industry, because he planned and instigated its change from a rather casual, often part-time rural activity into an organised, business-like production process

[662] Oldroyd, *Estates*, p.43.

aimed at profit and the enhancement of the Bowes family wealth. He fits neatly into Wilson's definition of an entrepreneur as someone with 'a sense of market opportunity combined with the capacity needed to exploit it'. [663] His role consisted of several functions; landowner and mineral lord; financier; managing director; and merchant. These functions manifested themselves in Bowes' ability to organise, a characteristic of entrepreneurial behaviour suggested by Mantoux in his discussion of the men who as manufacturers were at the forefront of economic change in the eighteenth century.[664] Bowes' objective was to control the supply of ore and pig lead on his estate, and he understood that the location of lead mining and smelting were determined by mineralisation and the sources of power and fuel. The management of labour and general mining activity were therefore his primary problem, and consequently George Bowes had to consider the scale of production and the relationship between costs and demand. Evidently he decided that small-scale mining and smelting was the optimum structure for lead production on his estate in the mid-eighteenth century, and accordingly he reorganised and integrated the different parts of the lead production process. He controlled the raw material and the product by means of a legally structured monopsony; at Bowes owned mines he paid for labour in order to enjoy the profits; and at some mines lent tools and equipment and gave cash advances against potential ore production. In doing so, George Bowes created a capitalist industry founded on small-scale enterprise, in which he controlled the means of production and property rights, and the preconditions for the expansion of lead extraction in the late eighteenth an nineteenth centuries. It is no exaggeration to say that without his entrepreneurship lead mining would not have developed during the

[663] C. Wilson, 'The entrepreneur in the industrial evolution', in B. Supple, *The Experience of Economic Growth: Case Studies in Economic History* (New York 1963) p. 176.

[664] P. Mantoux, *The Industrial Revolution in the eighteenth century* (London 1928, reprinted 1970) ch. 2.

mid-eighteenth century, and probably not after his death in1760.

Chapter 9: The Lady's Lead

George Bowes died without a male heir in December 1760, leaving the estate to his sole heir and daughter Mary Eleanor Bowes aged eleven. This unfortunate family contingency must have been anticipated and strenuous efforts were made to ensure the Bowes name and legacy remained intact. His will contained very specific instructions regarding the continuation and development of Bowes coal interests, but nothing about lead.[665] 'And my Will is that my Family Collieries may never be let but that the same may be carried on in the same manner as they now are…..'. Similarly, partnership and leasehold collieries would continue to operate in the same way: 'And my will is that my said Trustees shall not be compelled or compellable to sell and dispose of any part of my Stock in Trade or to call in any of my debts, but such as they shall think proper'. The will also stipulates that any surplus of rents and produce should be used to acquire more land. All aspects of lead production were conspicuous by their absence. Estate documents, mostly written by George Bowes, corroborate the omission of lead; they show significant valuations for the Bowes estate for the period 1752 to 1767, essentially Mary Eleanor's inherited fortune, but they are undated and contain no mention of lead production.[666]

The history of lead production can be sub-divided into three distinct periods for the years between George Bowes' death in 1760 and Mary Eleanor's in 1800: 1760 to 1771, when the estate management system filled the void after George Bowes' death, and the end of opportunistic, profit-driven Bowes business culture coincided with the marriage of Mary Eleanor Bowes; 1771-1792, when the London

[665] George Bowes' will of 1749 with codicils, under York Probate Court, is held at the York University Borthwick Institute of Historical Research. 1749 is significant, because it was the year of his daughters' birth.

[666] *D/St/C1/9/19*, accounts of Mary Eleanor Bowes fortune around the time of her father's death.

Lead Company held a lease for most of the Bowes lead mines in Upper Teesdale; and 1791 to 1800, when the mines reverted to the Bowes family, and production fell once again into the hands of lessees. This chapter examines the three periods identified above, and in particular 1760 to 1771, the years preceding the interregnum created by the arrival of the London Lead Company. Different aspects of the Bowes estate's lead business will be analysed; the management; the production of ore and pig lead; expenditure; and distribution and the market for the estate's ouput.

The transitional period from late 1760 to 1771 was in essence a continuation of the late 1750s prior to the death of George Bowes, when lead production was at a lower level than in the 1740s, but the overall condition of the lead industry on the Bowes estate was somewhat parlous. At the time of George Bowes' death and very shortly thereafter, the lead business appeared to have been unprofitable and suffering from weakened management and lack of direction. John Gibson remained in post at Wemmergill Smelt Mill and penned yet another detailed report in March 1761 demonstrating that lead mining was essentially a loss making enterprise, and argued that this was either because of poor veins or bad management, but clearly biased towards the latter, thereby implicating Nathan Horn's abilities as mines agent.[667] He showed that mining at Closehouse and Lunehead were in profit for the period from October 1758 until March 1761; the former made £32 4s 2d, the latter £23 13s 4d, and both had been let at one-sixth duty ore rather than worked by the Bowes. Birkdale, formerly Isabella Mea Hill, and still then regarded as having the greatest potential had, together with Blackark mine, suffered heavy losses from February 1759 to March 1761; Birkdale lost £466 4s 5d, and Blackark £340 7s 0d, totalling £807 10s 7d. Gibson argued that bad management in the form of dismissing

[667] *D/St/B2/93* John Gibson's report on production and profit for the lead mines dated 11th March 1761. Gibson had already suggested letting all mines at one-sixth duty in a letter to Stephenson of 17th May 1760, as well as in his reports of the late 1750s, which were examined in an earlier chapter.

the hushers and making costly bargains thereafter was the root cause of loss at Birkdale, and that it should have been leased at one-sixth duty because 'it is reckon'd the best in the Lordship', and added 'tis very probable larger Quantity of ore would have been produced'. Gibson concluded 'Tho' pretty large sums of Money are annually expended at the Mines, the Workmen in general complain of their Wages. And as so little ore is raised, the Mines must be either bad, or, imprudently managed. Hence, it would be more safe and advantageous to let them at duty'. In April 1761 he reiterated the poor state of the lead mines,[668] and mentioned an agent from a 'Derbyshire Company' viewing the mines which had made a loss.[669]

In October 1762 Gibson reported on the lead mines to Richard Stephenson at Gibside confirming little positive change; Birkdale seemed more promising, Lunehead and Closehouse both poor, Standards was promising, very little ore at Blackark, and a trial working in progress at Cocklake.[670] Evidently, most of the mines were being worked by hushing, but a very dry summer in 1762 had meant little lead ore was produced by this method. In September of the following year Gibson wrote that 'The mines in general are very poorly',[671] and his report included the East End of Lunehead, West End of Lunehead, Longstaff Hush, Closehouse, Standards, and Birkdale. Although lead was being extracted and smelted, the volume of production of both ore and pig lead concerned the estate managers.[672] In June 1768 Gibson's memorandum to Stephenson notes that no lead ore was being delivered to the smelt mill, and that he was setting out to visit the mines to discover why.[673] A year later Gibson, referring to the smelt mill at Wemmergill, noted that 'the Lead Mill

[668] *D/St/C2/3/77* letter to Stephenson 7th April 1761.
[669] *D/St/C2/3/77* Gibson to Stephenson 22nd April 1761.
[670] *D/St/C2/3/77* Gibson to Stephenson 5th October 1762.
[671] *D/St/C2/3/77* Gibson to Stephenson 19th September 1763.
[672] Production of lead ore and pig lead for this period is discussed Chapters 5 and 6.
[673] *D/St/C2/3/77* Gibson to Stephenson 8th June 1768.

has for some time been unfit for use', which reconfirms the rather bleak picture of lead production on the Bowes' estate during the 1760s.[674]

In summary, the period from George Bowes' death until the granting of an area lease to the London Lead Company in 1771, incorporating most of the mines on the Bowes estate, was an extension of activity in mining and smelting begun in the late 1750s. The output of both ore and pig lead evidently ground to a halt in the late 1760s, and Wemmergill smelt mill fell into disrepair before the end of that decade. Indeed, compared to the intermittent heightened production during the 1740s and late 1750s under George Bowes direction, lead on the Bowes estate reached its eighteenth century nadir in so far as the estate withdrew its direct involvement and low production and losses followed as outlined above.

There was no plan for the development of the industry on Bowes land during the 1760s; it was more a case of continuity rather than change, and the management was strained by the differing methods of individuals and changes in personnel. The management structure galvanised by George Bowes for the purpose of lead production remained in situ after his death, and, in the circumstances in which the Bowes estate now found itself – without a patriarch with business acumen and being run on behalf of a female minor – should have been the keystone for the survival and growth of a metalliferrous mining business on the family estate. Unfortunately, it appears that the management functioned, but lacked the benefit of George Bowes' direction. There was no substitute for George Bowes, and no widow like Lady Bowes of the early eighteenth century. Perhaps more significant is the fact that regardless of the apparent sophistication of the estate management structure, its development still relied upon the family.

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[674] *D/St/C2/3/77* Gibson to Stephenson 19th July 1769.

The conflicting approaches of John Gibson and Nathan Horn, as the lead mining and smelting specialists, have been discussed above, and after George Bowes died personalities continued to prick the management structure. Gibson's report of March 1761 identified once again the management of the mines as the source of the problem in Bowes lead production.[675] In a memorandum to Stephenson in April 1761, however, Gibson notes that Nathan Horn was expecting to be dismissed, then unreservedly complains that Horn received three times his own salary but failed to extract anywhere near enough lead ore, which in turn meant that Wemmergill mill was under capacity.[676] Gibson suggested that the 'Mill agent' did more than the 'Mine agent', therefore he should have been paid more to avoid having to work as a teacher to make up his income. Gibson asked for £20 per annum, which Horn had 'thought poor', meaning Horn would not have accepted it. Nathan Horn was discharged on 29th December 1761,[677] and in November 1764 Horn wrote, presumably

to Stephenson, regarding his disagreement over £13 he believed he was owed by Bowes.[678] The chronology of Gibson's correspondence and references therein to the lead mines, certainly from 1762 onward, suggest that Gibson had become responsible for Horn's role, in other words he was smelt mill manager and at least acting mines steward.

The recruitment of miners and smelters also incurred differences of opinion. Referring to John Langstaff as 'Setter on for some time', Gibson wrote to Stephenson in May 1763 expressing the view 'yet he very seldom handles the Gavelock, is not fit to be an Undertaker'.[679] Gibson added that it would be 'greatly

[675] *D/St/B2/93*, though in this report he does not name Nathan Horn.
[676] *D/St/C2/3/77* Gibson to Stephenson 22nd April 1761.
[677] *D/St/C2/3/38* Nathan Horn to William Leaton, dated 2nd January 1762.
[678] *D/St/C2/3/76* Nathan Horn's letter, probably to William Leaton, saying he will refer the matter to Mary Eleanor Bowes. She would be only 15 years old at the time.

disadvantageous to our Mistress' to employ the men John Dent had suggested.[680] He recommended John Baty, who had previously worked at Wemmergill. In 1769, however, John Gibson himself was informed by John Bourn, a relatively new middle-ranking steward, that he would probably lose his position because of lack of work, but agreed to pay his salary until Gibson found another job. In summarising Gibson's career as smelt mill manager for the Bowes, his loyalty and integrity are undoubted, yet he was under-paid and his potential probably underrated, because his insightfulness seems to have been ignored. He was numerate and literate, and clearly exhibited a deep understanding of the lead production process and the market for lead. The impression of Gibson is a man of intelligence with knowledge and a capacity for management which, if exploited earlier, could have been an appropriate understudy for George Bowes, who would have been in a better position to develop the lead-bearing potential of the estate on behalf of Mary Eleanor Bowes. Gibson told John Bourn that he did not want to 'leave the honourable Family at Gibside', but that he must because he needed a greater income.[681] Gibson's devotion and deference were trumped by the need for financial reward.

Lead mining activity from 1760 to 1771, measured in terms of tacks and leases granted, is most accurately described as being status quo ante George Bowes' death. Table 23 below lists those arranged after 1760.The tacks and leases agreed before his death remained in place with the exception of three new agreements: a nine-year lease granted to John Robson, Peter Allinson, and partners for ground at the east end of Black Ark mine known as Coe Bank;[682] a nine-year

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[679] *D/St/C2/3/77* Gibson to Stephenson 31t May 1763.
[680] *Ibid.*
[681] *D/St/C2/3/77* Gibson to Stephenson 19th July 1769. Gibson earned additional income from teaching.
[682] *D/St/B2/32* Thomas Colpitts II on behalf of Mrs Bowes to Robson, Allison and partners.

agreement for the West End of Lunehead;[683] and a six year lease to John Alderson and Jonathan Horn for Cocklake, a relatively new lead mine.[684]

Table 23

Tacks and lease granted 1761 to 1771

Year Ore	***Term***	***Lessees***	***Mine***	***Duty***
1761	9 yrs	John Robson, Peter Allison, & Partners	Coe Bank at Black Ark	1/6th
1761	9 yrs	Thomas Rain Robert Dent	West End of Lunehead	0
1762	6 yrs	John Alderson Jonathan Horn	Cocklake	1/6th
1771	21 yrs	London Lead Company	Birkdale Blacksike Closehouse Arngill Standards Cocklake	1/5th 1/6th 1/6th 1/6th 1/6th 1/6th

Source: *D/St/B2/32-35* inclusive

The potential for lead ore at Isabell-meah-hill, by this time known as Birkdale, continued during the 1760s. In March 1761 William Dent, who was working Green Mines,[685] wrote to Gibside estate office asking for a twenty-one year lease at Birkdale, but to no avail. Birkdale was worked by Jonathan Watson and Thomas Taden (Teding), and in September 1762 Gibson reported that 'the Partnership

683 D/St/B2/33 a memorandum
684 *D/St/C2/3/39* Henry Bourn on behalf of Mary Eleanor Bowes to Alderson and Horn.
685 *D/St/C2/3/75* Dent's letter to Stephenson regarding Birkdale and mentioning his ore for sale at Green Mines dated 19th March 1761.

at Birkdale have made some discovery'. [686] This mine was still the most productive and perceived as having most potential, so much so that it appears there was a plan to commandeer it by Bowes management employees together with other individuals experienced in the lead industry. Mary Eleanor Bowes does not appear to have formalised this partnership arrangement. A partnership agreement of 30th December 1762 included Thomas Colpitts II, a senior agent, John Gibson, the Wemmergill smelt mill manager, William Dent and Samuel Bacon and John Dent, whose names appear in various documents in the Strathmore records, James Elliot, Thomas Walton, Thomas Watson, and Mark Newby.[687] The terms of this agreement were for equal shareholdings, the preferential option of all partners to purchase the share of any partner leaving the partnership, otherwise he could sell to anyone acceptable to the remaining partners, and proxy voting if any partner could not attend meetings. Mary Eleanor Bowes' mother was not a named partner, nor is Thomas Colpitts II cited as acting on her behalf, though it may have been the case because some tacks and leases granted during the eighteenth century contained a Bowes' agent's name without mention of George Bowes. It would seem reasonable to suggest that, although these partners would benefit financially, key employees who had already demonstrated their abilities in lead production in effect, by creating a firm, planned to cocoon the lead mine with most potential. The eight-man partnership was working Birkdale in the year 10th June 1765 to 16th May 1766,when it produced 63.4% of Bowes lead mines output,[688] of which Mrs Bowes received one-sixth duty, although receipt of duty ore did not necessarily exclude her from acting in her own right or on behalf of her daughter Mary Eleanor as a partner.

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[686] *D/St/C2/33/77* Gibson to Stephenson of 7th September 1762.
[687] *Dt/St/B2/34* partnership agreement regarding mining at Isabell-meah-hill dated 30th December 1762.
[688] *D/St/B2/123* mines pay bill 1765/6.

In 1763 the East End of Lunehead was worked by Thomas Taden, the West End by Robert Dent, Langstaff Hush and Closehouse by Jonathan Watson, and Birkdale by Watson and Taden who had made the discovery in 1762,and Standards was also leased. By 1766 all lead mines leased at one-sixth duty ore: Arngill by Joseph Raine and partners who also had Standards, Birkdale by Thomas Colpitts II and partners, Cocklake by Joseph Collinson, Closehouse one vein by Jonathan Watson and the other by John Kipling and partners, Lunehead by Thomas Raine and Robert Dent.[689] There is no suggestion that the Bowes estate was directly working any lead mine on their land during the 1760s; they harvested a portion of the ore and bought ore from the lessees and elsewhere when leases determined, or when the market conditions made it worthwhile. The financial risk was minimal: expenditure on the purchase of ore by agreement, and occasionally the provision of tools and equipment to encourage miners to undertake extraction.

. In terms of mining activity, apart from the mines established before and during the George Bowes lifetime, there was very little new working. John Gibson's reports of the early 1760s narrate the decline of lead mining and smelting on the Bowes lands in Upper Teesdale. The lead vein at Cocklake, discovered in the late 1750s, became a trial mine in 1762 when it was in the hands of John Alderson and partners.[690] The only new operation undertaken directly by the Bowes was a nine-year agreement with Thomas Rain and Robert Dent that commenced on 25th March 1761. This was exploratory work from Cawsey Gill westward to Silverkellwell four hundred yards in breadth, which was the West End of Lunehead. Despite the term of the agreement it does not appear to have been the usual form of lease, rather a bargain with miners whereby tools and a smith's shops were provided on the field,

[689] The details of leases and mining activity are from *D/St/B2/123 and 127*.
[690] *D/St/C2/3/77* noted in Gibson's report to Stephenson of 5th October 1762.

which they agreed to repair if necessary, and Bowes paid them 35s a bing for mined and washed ore.[691] Overall, as John Gibson observed, lead mining on the Bowes estate

by the mid-1760s was in its death throes.

The use of tacks and leases as management tools for the development of lead mining on the Bowes estate is discussed above in chapter 4. There were only three new agreements before the granting of the London Lead Company's twenty-one year lease in 1771, but there contents mirrored those of the pre-1760 period. The arrangements for working provide a good example of the continuation of the tried and tested structure of the Bowes leases. The 1761 lease for the east end of Blackark, an area otherwise known as Coe Bank, permitted hushing, trenching, and driving together with the building of water courses for washing and dressing, on a piece of ground 800 yards by 400 yards. Mrs Bowes received one-sixth duty ore, washed and dressed ready for smelting, and preferential buyer status for the remainder of the ore extracted. The lease would be forfeited if less than four men were mining for one month.[692] The 1762 lease for Cocklake contained an arrangement for working an area of ground 100 by 800 yards at one-sixth duty ore, and would be forfeited if not worked for two months, except in storm or tempest. Again, ore must be washed and dressed and Mrs Bowes, on behalf o the estate, had first option for the rest of the ore after duty ore had been deducted. Henry Bourn granted this lease on behalf of Mrs Bowes, and he included a clause stipulating that the lessees must give one week's notice for the weighing of ore.[693] Quite clearly, the lead leases continued to be employed as instruments of control, and stewards were concerned about the accuracy of their contents and practice once agreements were in place. For example, John

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691 *D/St/B2/33* Memorandum
692 *D/St/B2/32* Thomas Colpitts II on behalf of Mary Eleanor Bowes to Robson, Allison and partners.
693 *Ibid.*

Bourn wrote to William Leaton requesting his advice in August 1762 when the lessees at Cocklake queried the practice of his retaining the copy lease he had signed on behalf of Mrs Bowes. Bourn wondered whether or not the Bowes would prefer a clause to be inserted in future leases covering this type of dispute.[694] Leaton' reply of 2nd September 1762 confirmed that Bourn's actions were correct, and therefore no change in practice was necessary.

It would be churlish to undertake a comparative analysis of the differences between this lease and those granted to small-scale partnerships and individual miners who were the usual categories of lessee interested in lead mining on the Bowes estate prior to the arrival of the London Lead Company. The decision was made to withdraw from not only direct involvement in lead production, but also the management of groups of adventurers and miners who would otherwise have risked relatively small amounts of capital in the search for lead in Upper Teesdale. The opportunity arose for an area lease that embraced most of the established lead mines on the Bowes estate, with an expectation of significant investment in the development of the mineral rights by applying large-scale mining methods and up-to-date technology together with professional business methods in terms of management, accounting, and marketing. An extremely wealthy landowning family welcomed a range of benefits for the future heirs to the estate, whilst simultaneously ensuring the best possible arrangement for those living and working on it. The insertion of clauses regarding wages and general working conditions for the benefit of the local inhabitants is an excellent example of paternalistic philanthropy. The Bowes estate dictated the terms of the lease to the largest lead producer in Britain, but obtained not only beneficial terms for themselves but also for the labour force, many of whom

694 *D/St/C2/3/39*, Bourn to Leaton of 27th August 1762.

would be rent-paying tenants, on their lands. The economic value of an extractive industry, in this case metaliferrous mining, on a landed estate to both the owners and those who needed to earn a livelihood from it is crystallised in this relationship between family capitalism, in the form of a landed estate, and corporate enterprise. Once again the Bowes became rentier mineral owners, almost by default in this instance, foregoing the market opportunity for lead, yet through the medium of the lease with the London Lead Company imposed a long-term, broader process of economic and social development in Upper Teesdale by seeking to protect incomes from the lead industry, which in turn would assist in suppressing rent arrears on Bowes land where the dual occupation of farmer/miner and that of full-time miner were key components in the upland frontier economy.

Lead mining activity was generally at a low ebb at this stage on the Bowes estate, a condition regularly reported by John Gibson during the early 1760s, as noted above. Apart from interest in Birkdale, Green Mines was worked, but the only surviving record notes that John Smith sought a twenty-one year lease at Black Sike mine.[695] There are only a few extant records 1760s regarding the productiveness of the lead mines, but an estimate can be made for the years 1761 to 1764 based upon the stock figures for pig lead smelted (see Table 27 below), though this may give an under-estimate, because the stock figures may disguise sales of lead locally. Evidently Bowes agents reckoned that four bing and one horse of ore produced one fother of pig lead,[696] and accepting that a fother of lead consisted of sixteen pieces, then at least approximately 271 bing of ore was extracted over a four-year period on the Bowes estate, which confirms Gibson's view, noted above, that the Bowes' lead mines were

[695] Mentioned in William Dent's letter to Stephenson of 19th March 1761.
[696] *D/St/C2/3/39*, John Bourn to William Leaton of 10th June 1763 regarding lead production.

in a dire condition and comparatively undeveloped.

There are some statistics of ore production for the two years May 14th 1763 to May 16th 1764 and 8th June 1765 to 16th May 1766, which are different accounting years than for pre-1760 records. Table 24 below incorporates the available information for ore produced and goes some way to confirming the estimate already made for the production level of lead ore extracted during the early 1760s.

Table 24

Lead ore output 1763/4 and 1765/6

	1763/4			1765/6		
	Bings	horses	pokes	Bings	horses	pokes
Closehouse	8	0	0	25	2	1
Lunehead	17	0	0	24	3	0
Standards	7	2	0	19	0	0
Cocklake	2	3	0	20	0	0
Arngill	no data			7	1	0
Birkdale	no data			167	0	0
TOTAL	35	1	0	263	2	1

Source: *D/St/B2/127* smelt mill pay bill documents

The level of Bowes' financial commitment shrank significantly after 1760; the 'putting in' capitalism – lending tools and equipment, and sometimes advancing money - which characterised the George Bowes era all but disappeared during the 1760s. Expenditure was focused on the purchase and carriage of lead ore, the carriage of pig lead to Newcastle, and the operation of the Wemmergill smelt mill

until its production expired after 1766. Expenditure on lead mining was non-existent, even at Birkdale. Table 25 below shows expenditure for the two years 1763/4 and 1765/6.

The consequences for expenditure following the building of the Wemmergill smelt mill were discussed above in chapter 7. Ore carriage costs almost doubled over the two year period for which records exist, and since the rate of carriage, 2s per bing with the exception of Birkdale ore, which was 3s per bing, ore

Table 25

Expenditure on carriage and smelting in 1763/4 and 1765/6

	1763/4			1765/6		
	£	s	d	£	s	d
Ore carriage	3	10	6	6	11	0
Lead carriage	14	0	9	10	1	6
Smelting	9	13	4½	3	4	4½
Total expenditure	41	1	9½	35	7	5½

Source: *D/St/B2/127* smelt mill pay bills
Total expenditure included all of the above items, together with any other labour, repairs, carriage and purchase of materials – mainly coal, lime, and peat – washing and dressing of slags, and any incidental expenditure.

production in 1765/6 must have been approximately twice that of 1763/4. Lead carriage costs to Wolsingham fell 28%, which indicates that the movement of lead was slower in1765/6 compared to two years earlier. Lastly, the costs of smelting pig lead, both ore hearth smelting and slag smelting, dropped by almost two thirds over this two year period, stark revelation of the decline in metallic lead output and the dying embers of an ailing rural industry on the Bowes estate. The rate of pay for

smelting was unchanged in the two years identified in Table 25: 7s. per piece for ore hearth lead, and between £3 3s and £4 18s per fother for slag smelting, subject to the quality. In 1763/4 ore carriage costs were a little over 8% of total expenditure, and lead carriage costs 34% i.e. total carriage costs amounted to just over 42% of total Bowes expenditure in the categories outlined above. In 1765/6 they were 18.5% and 26.75% respectively i.e. 44.25% of total expenditure. In other words, the costs of carriage of both ore and pig lead change only very slightly over this short period. The the rate of carriage per bing remained unchanged, but a larger proportion of the extracted ore was from Birkdale, which as noted above, cost one third more to transport, so it must account for much of the increase in ore carriage costs.

The limited information illustrated in Table 25 above highlights the fact that during the 1760s the Bowes were only active in the carriage and smelting stages of lead production, and even then only in a small way. Essentially, the small scale lead business that Mary Eleanor Bowes inherited from her father was tolerated whilst in the end stage of production. The under-age and unmarried heiress was both incapable and uninterested in directing the development of lead mining and smelting which in its nascent stage benefited from the nurturing it received from George Bowes. Moreover, the estate managers specialising in lead did no more than subtlety take advantage of the positive market conditions in the post war period; ironically, John Gibson's detailed reports immediately prior to and following the death of George Bowes recommending the way to develop lead mining may have been the primary influence, more so than market conditions, in deflecting more senior stewards from advising his widow and their daughter Mary Eleanor Bowes to permit, and invest in, the development of lead production on the family estate. After all, the management had overseen and witnessed the demise of lead as an estate activity after

the initial euphoria of the 1740s, and must have realised by then that progress required capital investment for deeper mining.

Table 26
Prices of Pig Lead per Fother 1760 to 1800

Year	**Sale Prices** (Strathmore)			**Prices at Blaydon** (Hughes)					
				Highest			Lowest		
	£	s	d	£	s	d	£	s	d
1760				12	7	6	11	0	0
1761				14	0	0	12	5	0
1762	14	15	0	14	5	0	13	12	6
1763	15	12	6	15	15	0	14	17	6
1764				14	10	0	13	10	0
1765				15	5	0	13	10	0
1766				15	5	0	14	17	6
1767				15	5	0	14	15	0
1768				15	2	6	14	10	0
1769				14	7	6	14	10	0
1770				14	5	0	14	0	0
1771				17	14	0	14	0	0
1772				15	0	0	13	15	0
1773				13	2	6	12	17	6
1774				13	15	0	12	15	0
1775				14	0	0	13	15	0
1776				14	0	0	13	5	0
1777				13	15	0	13	7	6
1778				13	7	6	13	0	0
				Average Price (Burt)					
				£	s	d			
1779				13	8	0			
1780				13	8	0			
1781				15	14	0			
1782				17	16	0			
1783				18	12	0			
1784				17	10	0			
1785				18	0	0			
1786				17	16	0			
1787				20	6	0			
1788				23	4	0			
1789				21	10	0			
1790				18	18	0			
1791				19	18	0			
1792				21	2	0			
1793				20	4	0			
1794				18	18	0			

1795	18	4	0
1796	21	4	0
1797	19	10	0
1798	19	2	0
1799	21	4	0
1800	23	8	0

Source: Burt, *British Lead*, Appendix A; Hughes, 'Lead, land and coal', Appendix Table 13; and *D/St/B2/150*

The Bowes lead output during the first half of the 1760s was in response to the rising prices after 1760 and the expectation of an immediate post-war increase in demand when overseas markets reopened to British lead exports. This was a well established pattern of behaviour, as noted above in chapter 7, but George Bowes' reaction to pre-Seven Years' War price increases caused by war demand for lead was not sustained. Evidence of prices for the period 1760 to 1800 is given above in Table 26.

Pig lead output on the Bowes estate tailed off after 1764 and the smelting of lead at Wemmergill had ceased no later than 1769.[697], even though the market price for pig lead at Newcastle increased 23% from 1760 to 1768. Apart from 1771, the trend of prices was downward until 1781. Roger Burt estimates that lead output grew to between 50,000 and 60,00 tons per annum during the third quarter of the eighteenth century, with an inconsiderable decline noticeable in the 1770s and 1780s.[698] There are several items of data missing from the records, but it can be seen from Table 27 below that lead production continued after 1760 with net accumulated stock at the staith growing to 3455 pieces of smelted lead, or 216 fodders, yet this was small-scale output compared to other producers. Production continued, but at a reducing rate, so that by 1769 the Bowes lead business appears to have ceased. Prices for pig lead began to fall in 1767, a trend which continued throughout the 1770s, with

[697] *D/St/C2/3/77* John Gibson to Richard Stephenson at Gibside.
[698] Burt, *Lead Production*, p.265

the exception of 1771.

Table 27

Pig Lead Output, Deliveries, and Stock measured in Pieces - 1761 to 1768

Year	Pieces Smelted	Pieces Delivered to Wolsingham	Pieces Delivered [699] to Tanfield Moor	Delivered to Staith	Stock pieces
1760				258	2434
1761	434 [700]	408	199	153	
1762	261	98	47	261	2848
1763	400	422		409	
1764	388	106	346	366 [701]	3455
1765	203				
1766	194				
1768	96				

Source:
For lead smelted *D/St/C2/3/77* Gibson to Stephenson correspondence, and *D/St/B2/150* accounts; for deliveries to Wolsingham *D/St/B2/150, D/St/C2/3/75* William Carr's letter to Stephenson, and *D/St/C3/77* Gibson to Stephenson letter; to Tanfield Moor *D/St/B2/150*, and *D/St/C2/3/77* Gibson to Stephenson letter; to Staith *D/St/B2/150* accounts, and for stock *D/St/B2/150* accounts for lead smelted; and for 1756 and 1766 *D/St/B2/127* Wemmergill smelt mill pay bill

That pig lead output and the trade in lead ore were sensitive to the price mechanism at the end of the Seven Years War in 1763 is brought out in the

[699] From *D/St/B2/150* accounts of lead smelted and led from Wolsingham to Tanfield Moor.
[700] *D/St/C2/3/77* Gibson to Stephenson 4th December 1761giving lead smelted between 16th June and 4th December 1761, as opposed to the figure for lead delivered to Wolsingham or Tanfield.
[701] *D/St/E5/15/52* account of lead to the staith notes that 22 pieces were used at Gibside.

correspondence between Bowes stewards and agents about market conditions. At the end of 1762 Richard Stephenson at Gibside wrote to John Bourn requesting that he should buy ore whilst it was cheaper before the price of pig lead rose. Shortly afterwards he asked Bourn to mark pig lead smelted from the cheaper ore in order to distinguish it from the rest when it reached Tanfield Moor.[702] It has already been noted

above that the market price of pig lead determined the price of ore in the field. Indeed, as early as May 1760 John Gibson advised Stephenson to prepare for higher prices at the end of the war by purchasing cheap ore while it was available.[703] By late 1762 Bourn wrote to William Leaton asking the price of a Newcastle fodder, simultaneously informing him that pig lead had been delivered to Newcastle, exclusive of expenses, at under £13 per fother,.[704] In other words, it could be sold for a competitive price, as shown in Table 27, and Bourn noted that he 'suppose the Markets are rising'. There is no evidence of panic buying of lead ore, but purchasing activity can be described as hasty, in the knowledge that a war was in its latter stages and a stronger overseas demand was likely to affect the market for lead imminently, though the extent of this demand appears not to have outweighed regional supply to the Newcastle market because prices became relatively stagnant, as seen above.

The recurrent problem of whether Newcastle or Stockton should be the market for Bowes pig lead rose its head again late in 1760, just prior to George Bowes' death, and remained in post-war market conditions. In October 1760 Nathan Horn wrote to William Leaton at Gibside stating that he had calculated it was 13s 11d cheaper per fother to carry smelted lead from Wemmergill to Stockton rather than to the Bowes' staith at Dunston on the Tyne.[705] And, true or not, Horn stated that

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[702] *D/St/C2/3/75* Stephenson to Bourn of 27th December 1762.
[703] *D/S/B2/3/77* Gibson to Stephenson of 17th May 1760.
[704] *D/St/C2/3/39* John Bourn to William Leaton of 20th October 1762.
[705] *D/St/C2/3/38* Horn to Leaton of 13th October 1760.

John Gibson concurred. This was contrary to George Bowes' own assessment of lead carriage to market in the 1740s when he decided upon Newcastle as the cheaper option for the reasons outlined above. Perhaps there had been an increase in carriage costs to Newcastle. Importantly, Horn confirmed that Yorkshire lead made 5s more per fother than Bowes lead, which meant either that there was a greater margin to be had by carrying and selling pig lead in Stockton, or that pig lead from the Yorkshire dales was of better quality. In the context of Horn's correspondence, it probably meant Bowes could get more for their lead in Stockton, hence the argument in favour of directing lead there. During the summer of 1763 Leaton wrote to Bourn instructing him to base his ore purchases on a guide price at Newcastle of £15 12s 6d per fother .[706] This meant buying ore at no more than £3 1s a bing, whereas John Bourn was negotiating around the £3 10s mark for Birkdale ore.[707] Leaton informed Bourn in June 1763 that he could not obtain £15 15s per fother for Bowes lead in Newcastle in the current market,[708] which indicates that regional producers were beginning to over supply the Newcastle market. Leaton made a further qualification regarding the Newcastle market, that 'The Best refin'd Lead has not sold for above £16 at Newcastle as yet', and furthermore that lead had sold at Stockton for £18 per fother.[709]

William Leaton's last word on the matter was 'I suppose you can buy no oar till ye Stockton and Newcastle price come nearer together'.[710] Again Table 27 above shows that Newcastle pig lead prices did not reach expectations, and certainly not the level Leaton quoted for the Stockton market. In fact Bowes lead was selling at £14 15s per

[706] *D/St/C2/3/39* Leaton to Bourn of 12th June 1763.
[707] *D/St/C2/3/39* Bourn to Leaton of 10th June 1763.
[708] *D/St/C2/3/39* Leaton to Bourn of 12th June 1763.
[709] *Ibid*.
[710] *Ibid*.

fother in November 1762,[711] which was above the price quoted for Blaydon. Newcastle

prices appear to have stagnated in the mid 1760s, then dropped in 1769. There are no records for smelted lead output for 1765, but there is clear indication that it was no longer considered automatic to carry pig lead quickly to Wolsingham and then to Tanfield Moor and the staith. In the summer of 1765 John Gibson at Wemmergill sought instructions from Richard Stephenson at Gibside as to whether or not more lead should be moved.[712] The movement of pig lead to the Newcastle market was no longer a rush: the Bowes at this stage were carrying stock, because the level of sales locally had declined.

The lead trade was highly price sensitive at this time, and it was often more profitable to sell ore rather than pay the cost of smelting and carriage only to end up with stock that could not be sold in the short term at acceptable prices. The Birkdale ore Bourn was interested in buying had received an offer of £3 10s from Mr Elliot, a smelter whom the Bowes estate had dealt with previously, and Elliot described this price as 'five shillings within the Stockton Market'.[713] Consequently, Bourn suggested to Leaton that if Elliot was willing to buy this ore at £3 15s, then Bourn should sell Elliot the Bowes duty ore and not bother smelting it, and encourage Elliot by offering six months credit for payment 'with proper security', which presumably meant a bond from Elliot. On another occasion Bourn was n competition with 'the Potters', presumably either smelters or lead merchants from outside the area, for 40 bing of Birkdale ore which he described as 'the finest and best that ever I did see'.[714] He had offered 49s per bing, but the Potters had offered 59s,

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[711] *D/St/C3/77* John Tempest's bill for £58 7s 8 ¼ d for 3 fothers 20 cwt 0qtrs 14 lbs of pig lead, dated 10th November 1762 at 21 cwt to the ton i.e. a Newcastle fother.
[712] *D/St/C2/3/77* Gibson to Stephenson of 2nd July 1765
[713] *Ibid*. These are John Bourn's words to Leaton.
[714] *D/St/C2/3/38* being John Bourn's memorandum to Gibside steward

and again Bourn suggested that if the competition would pay 59s then Bowes duty ore too should be sold to them at that price. Clearly, to sell ore on was often the most profitable option if the market price for pig lead was insufficient to make smelting and carriage costs worthwhile. John Bourn had calculated that if he paid £3 10s for ore, the end product, metallic lead, would sell for £17 per fother in Newcastle,[715] but his leading steward pointed out the reality of the lead market; that demand at that price did not exist, and would not be until the early 1770s (Table 27 above).

The surviving accounts for lead smelted and delivered confirm two things; firstly, that Bowes lead continued to be marketed in Newcastle rather than Stockton, though the option of selling pig lead there was evidently a serious consideration during the market conditions of the early 1760s and the cessation of war in 1763; and secondly, that most lead produced on the Bowes estate was sold in Newcastle.

Table 27 above, which is derived from the sources cited, a combination of accounts and correspondence written by individuals in the Bowes management structure, demonstrates that lead carriage continued to be along the route established during the mid-eighteenth century – from Wemmergill to Wolsingham, then onward to Tanfield Moor whence the lead was transported on the waggonway down to the staith at Dunston on the River Tyne. Pig lead was often stored at Wolsingham or left resting at the mill, subject to the level of urgency imposed by the Gibside steward. There is no evidence that Bowes lead ever reached Stockton, regardless of allegedly higher prices there. It has been discussed above that the Newcastle market was more attractive for a variety of reasons, particularly the existence of lead manufacturing as well as coastal and foreign trade.

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[715] *D/St/C2/3/39* Bourn to Leaton of 10th June 1763.

It was the magnetism of the Newcastle market and the ability to sell to local customers on the back of their standing in the mercantile community which caused the Bowes to leave the logistics of lead production unchanged. They had but a few customers for their lead; Peareth & Sorsbie, who had a long-standing business relationship with the Bowes; Mr. Tempest; and Thomas Hanby, who appears to have been a local plumber dealing with the Bowes from the late 1750s. In 1762 Mr Tempest bought 80 pieces of pig lead; equivalent to 30.65% of the lead smelted that year and 2.8% of the stock then currently held at the staith of 2848 pieces .[716] Peareth & Sorsbie bought 2946 pieces of lead in 1764, which was 85.3% of the Bowes stock.[717] Assuming sixteen pieces a fother and a price of £14 10s, this sale amounted to

£2,669 16s 3d. In October 1764, after the sale to Peareth & Sorsbie, only 319 pieces are recorded as resting at the staith, which means a further 190 pieces were sold, but the purchaser cannot be identified from the documents examined. Thomas Hanby is mentioned in certain correspondence in connection with Mr Tempest's purchases of lead, and it may be that it was he who bought the 190 pieces.[718] The quality of Bowes lead seems to have been known and recommended; in 1762 John Legg seeking to buy pig lead on behalf of Mr Tempest, for work to be done by Thomas Hanby, wrote that Hanby considered that 'Mrs. Bowes to be the best' of lead produced locally.[719]

Most of the lead mines established on the Bowes estate, regardless of their scale, were leased in 1771 to The Governor and Company for Smelting down Lead with Pit Coal and Sea Coal, otherwise known as the London Lead Company or

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[716] *D/St/B2/150* accounts of lead smelted.
[717] *Ibid*.
[718] *D/St/C3/55* Thomas Hanby to Stephenson 30th May 1763, and John Legg to Leaton for Mr. Tempest referred by Thomas Hanby to Mrs Bowes.
[719] *Ibid*.

Quaker Lead Company.[720] This twenty-one year lease marked the end of the George Bowes era, because the changes he wrought were not developed during the interim period before the London Lead Company ventured south of the River Tees, thereby extending their existing enterprise and capturing the monopoly of lead mining in Upper Teesdale. Lead production did continue after her father's death, on the basis of existing arrangements, and the Bowes estate management structure facilitated the continuation, but without plans for expansion.

After her Father's death and before her marriage, Mary Eleanor Bowes was all but neglected by her grieving mother Mary Bowes; they moved to London and the management of the estate in the North was left to the stewards[721]. Mary Eleanor received no guidance in estate business. Although by the late eighteenth century wealthy members of the landed estate tended to show interest in but distanced themselves from business and industry, the behaviour of Eleanors' Mother was in complete contrast to that of George Bowes mother, Lady Bowes, who was active in the coal trade in the early eighteenth century. Perhaps the late eighteenth century culture as reinforced by gender in the case of the Bowes, but in any event the retreat to London appears to have marked Mary Eleanor's withdrawal from estate business, including lead.

Upon marriage, Mary Eleanor and her new husband The Earl of Strathmore decided to grant a lease, which encompassed the whole lead mining area of the Bowes estate. The six mines included in the area lease Isabell-meah-hill or Birkdale, Blacksike, Closehouse, Arngill, Standards, and Cocklake; the Lunehead

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[720] *D/St/B2/35* John Bowes, Earl of Strathmore, and Mary Eleanor Bowes, to The Governor and Company for Smelting down Lead with Pit Coal and Sea Coal, dated 12th May 1771.

[721] W. Moore, *Wedlock* (London 2009) pp.30-32.

complex, Green Mines, and Blackark were excluded. The Bowes were to receive one-fifth duty ore from Birkdale and one-sixth from the other five mines; once again, in similar fashion to the Bowes of the seventeenth century, lead production became a rentier activity with the Bowes as indifferent lessor mineral lords, yet with one difference – the London Lead Company had the resources to develop the Bowes mineral asset, which in turn could enhance the value of the family estate without any risk for the Bowes. Risk-averse family capitalism had given way to corporate adventurism and the capacity for large-scale lead mining.

The 1771 agreement with the London Lead Company was unique in terms of its contents: the Bowes' management of a corporation created for the purpose of large scale lead mining operations necessitated a lease the like of which had not been previously drafted. The details of this twenty-one year lease were as follows:

1. The LLC was not to stray from the exact areas allocated at each mine i.e. 1800 by 400 yards. The mines included were Isabell-meah-Hill or Birkdale, Blacksike, Closehouse, Arngill, Standards, and Cocklake.

2. It was permitted to erect appropriate buildings and watercourses, heap rooms, and mills, including 'smelting engines and gins', and shops for miners.

3. The LLC was granted wayleave for the carriage of ore and pig lead over Bowes lands.

4. Materials for building and fuel could be taken from the Bowes lands.

5. The LLC was permitted to sub-let the lead mines contained in the lease.

6. Duty ore was one fifth for Birkdale and one sixth from the other mines named in the lease.

7. The LLC was to give ten days notice for the weighing of lead ore, and it was forbidden from carrying off ore without it being weighed and inspected by a Bowes agent.

8. The LLC accepted complete financial liability for the mines contained in the lease.

9. The security of the lead ore was the responsibility of the LLC.

10. Accounts of ore must be sent to the Bowes.

11. The LLC's books and accounts must be open to inspection by Bowes' agents.

12. The lead mines must be worked for at least nine months of the year, and there must be a minimum of four 'pickmen' at each of the six mines. The exceptions to this were events caused by combinations, civil war, and serious accidents, drought, and severe weather.

13. There were to be monthly inspections of workings, including shafts.

14. The LLC must pay wages at the current rate, and no less than annually, and this included carriers

15. The LLC must provide proper accommodation for miners and other workers.

The period following the granting of the London Lead Company in 1771 and before the death of Mary Eleanor Bowes in 1800, a span of only eight years, and indeed the continuation of lead production during the nineteenth century on the Strathmore estate in Upper Teesdale, is beyond the scope of this thesis. At this stage, however, some comment can be made regarding the years before the death of the Bowes heiress by way of shedding some light on the general condition of the British lead industry and how the Strathmore estate handled its potential lead production.

The market for lead was relatively buoyant in the last three decades of the eighteenth century, mainly because general domestic demand had expanded [722] and even though the War of American Independence between 1776-1783 interrupted the export trade in lead by reducing the average tonnage exported by twenty per cent compared to the period 1768-1774.[723] In addition, lead output in the Mendips and Derbyshire, the latter long recognised as the centre of British lead production since the sixteenth century was slowing down.[724] The supply of lead lagged behind growing war demand during the 1790s and into the first decade of the eighteenth century, and consequently the were huge increases in pig lead prices

[722] Burt, *British Lead*, p. 224.
[723] *Ibid*. p.239
[724] *Ibid*. p.224

as shown in Table 26 above. Simultaneously, the growth of domestic demand during the French and Napoleonic Wars of 1793-1815 was greater than the shrinkage in exports caused by war.[725] The Bowes, however, passed on the opportunity of substantial profits from their Upper Teessdale mines by granting a twenty-one year lease to the London Lead Company.

The market conditions prevalent between 1771 and the early nineteenth century lead to the assumption that the London Lead Company demonstrated almost perfect timing in agreeing a lease which would further enhance its lead output as demand grew. Unexpectedly, no records were discovered of correspondence between the London Lead Company and the Strathmore estate during the term of the lease, 1771 to 1792. The terms of the lease indicate its importance as a source of estate income, and the clauses stipulating the relationship between the Strathmores and the London Lead Company by way of practice and the exchange of management information, yet there is no evidence of any mining or smelting during the twenty-five year term. Perhaps the London Lead Company did not undertake any operations, or maybe it decided to sub-let the mines. Furthermore, there is no evidence of the enforcement of the forfeiture clause. Either way, a void appears to exist in the Strathmore Collection for lead production in the late eighteenth century on the family estate, and perhaps more significantly for the duration of the longest lease granted to the largest lead mining company, and one capable of large-scale investment to develop the mines.

It may be, of course, that documents relating to the extraction and smelting of lead performed by the London Lead Company are held elsewhere, for example in the Company's own records. A brief examination of lead business records

[725] *Ibid*. p.240

in the Strathmore collection for the years 1792 to 1800 reveal a renewed regional interest in lead evidenced by proposals to obtain leases from experienced miners, merchants, and local professionals, most notably in Weardale, which remained a regional hub for the lead industry. It could be suggested that there was a queue of adventurers awaiting the departure of the London Lead Company; partnerships of various sizes expecting to benefit from extensive mining operations conducted by a probably the largest British lead mining organisation of the eighteenth and nineteenth centuries. Without the London Lead Company records the history of the lead industry on the Bowes family estate during the latter years of the eighteenth century remains incomplete.

Chapter 10: Conclusion

The preceding chapters have examined two centuries of the Bowes estate's relationship with its lead mineral rights. They go some way to closing the gap in the existing knowledge of lead production in the northeast where the market, concentrated on Newcastle as the entrepot supplying London's consumption and international export, appears to have been in the hands of only a few producers, an oligopoly, from the late seventeenth century. The extent and nature of changes in the Bowes' role was largely determined by patriarchal dynamism – the role of male heads of the family. Yet notwithstanding variations in entrepreneurial capability, the history of the family's involvement in a major regional extractive industry demonstrates continuity in a number of ways. There are conclusions to be drawn about different aspects of lead production on the Bowes estate between 1550 and 1771, and for wider debates in economic and social history.

Bowes family members became leading figures in the northeast lead industry during the late sixteenth century, founded upon business acumen, social and political standing, and Crown favour and patronage.[726] They were directly involved in mining, smelting, and trade from at least 1550, demonstrating gentry entrepreneurship contrary to the prevailing view, yet were not granted mineral bearing lands by the Crown until 1593.[727] The Bowes, in the vanguard of upper gentry enterprise in mineral exploitation, seized the opportunity for profit presented by mines leased from the Crown in Teesdale, and in Weardale, the most productive, from the Bishop of

[726] See Chapter 2, James, *Family*, and Newton, *North East England.*
[727] Heal & Holmes, *Gentry*, pp.101-103, &159.

Durham.[728] Smelting was the keystone of the Bowes lead organisation, and Sir William

Bowes built a water-powered bellows-blown smelt mill before c.1595 – an exception to the view that gentry were exploiters rather than innovators – which changed the spatial organisation of this mining area, whilst the technology and techniques of lead production remained otherwise unchanged.[729] There is no evidence of any direct foreign

influence, either in the form of capital or technical expertise, upon their achievements in the late sixteenth century. The Bowes were the chief lead merchants in Newcastle-upon-Tyne with an effective monopoly created via the regulation of the Merchant Adventurers. They also supplied London merchants and the north European market, the former often providing working capital for mining to the order of several hundred pounds per contract.[730] The dearth of statistical records prevents meaningful extrapolation, but a reasonable estimate is achievable for the Bowes' role in northeast lead production. In 1599 they supplied 80 fothers of pig lead to the Newcastle market, and 100 in 1600. In 1601 Newcastle shipped out 59 ¼ fothers. By way of an inter-regional family comparison, in 1600 the Bowes lead supplied to Newcastle was equivalent to 42% of that produced by the renowned Talbot family in Derbyshire.[731]

The Bowes were leading northeast lead producers between *c*.1564 and 1600 – lessee entrepreneurs – yet vacated their position in an expanding market underpinned by the demands of domestic construction during the seventeenth century.[732] Their role, evidenced by extant leases, metamorphosed into passive, rentier activity on their Teesdale estate.[733] The Bowes' relative inactivity in lead production

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728 Hatcher, *British Coal*, p.254.
729 Holderness, *Pre-industrial England*, p.151.
730 *D/St/B2/142-145* recognizances or bonds; and Raistrick & Jennings, *History*, p.41.
731 Gough, *Rise*, p.134; Holderness, *op cit*.
732 See Chapter 3, and Clay, p.57; C. Wilson, *Apprenticeship*, p.85; Coleman, *England*, p.165; Blanchard, *Age*, p.48; and Platt, *Great Rebuilding.*
733 *D/St/B2/1-10* inclusive 1679-1712.

was not a consequence at any stage of either the existence from the 1560s, or its extinction in 1693, of the Mines Royal, an oft promoted cause of landowners' failure to exploit minerals. There are identifiable reasons for this change.[734] In 1611 the Bowes lost the Bishopric lead lease, the Moormastership, when Sir William Bowes died without male issue; the loss was substantial and never regained, and the Bowes' estate mines were insufficiently developed to replace it. Until Sir William Bowes attained his majority in 1677 there was an absence of patriarchs capable of developing the family estate.[735] It could also be argued that the family's socio-economic and political standing waned as a consequence of the Bishop of Durham's relationship with the Crown. Between 1679 and 1712 there was negligible commitment to discovering new and exploiting existing lead veins; lead production on the Upper Teesdale estate was viewed as a risky, incidental source of income, and its nature was haphazard and intermittent. The Bowes were laggards compared to other organisations in the northeast, namely the Blacketts and the London Lead Company, and it would appear their interest in lead did not extend beyond the estate. Sir William Bowes was preoccupied with profits from coal following his marriage in 1691 to the coal heiress Elizabeth Blakeston of Gibside, mother of George Bowes, and to a lesser extent with his business relationship with ironmaster Ambrose Crowley III.[736]

George Bowes became the estate's patriarch in 1722, when the family's wealth from coal was already established, later enhanced by his membership of the coal magnates' cartel – the Grand Alliance. Despite such wealth, he personally directed the development of the estate's lead producing potential.

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[734] See Chapter 3.
[735] Stone, *Crisis*, discusses the effects of such family misfortunes p.169. See also Heal & Holmes, *Gentry*, p.24.
[736] Flinn, *Men*, p.117, and Hughes, *North Country*, p.63.

Bowes inherited an unchanged estate management structure established in the late seventeenth century, but was innovative in his introduction of stewards specialising in mining and smelting, respectively Nathan Horn and John Gibson, who brought better integration of mines and mills. This commercialisation of the estate, management for gain, was transfused with George Bowes' insistence on a regular flow of stewards' management reports, sometimes directly to him in London.[737]

Bowes and his stewards' primary management tool was the development of the mining lease, which legally crystallised the Bowes monopsony of lead ore and the control of smelting.[738] Leases did not take a generic form; individualisation of arrangements subject to circumstances and conditions is the striking feature of Bowes estate management between 1740 and 1760. The leases were the basis for strict management – Bowes' regulations – rather than customary arrangements and mining laws, and frequently incorporated partnership agreements when shared risk was preferred. Equipment and tools, steward expertise, and sometimes money were 'put in' through the medium of the lease, demonstrating the Bowes estate operated as a capitalist firm, albeit family based and to an extent paternalistic.[739]

During the period 1740-60, as a consequence of an unprecedented approach to the possibilities of a metalliferrous product, lead production became a more organised economic activity on the Bowes estate in a barren landscape. Exploration, discovery, and mining became an embedded, continuous process and expectations were high in anticipation of finding sources of silver.[740] In 1748/9

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[737] See Chapter 4.
[738] *Ibid.*
[739] Coase, 'Firm', pp. 386-405, and Pollard, *Genesis*. For a view based upon social inequality and conflict see A. Woods, *The Politics of Social Conflict: The Peak Country, 1520-1770* (Cambridge 1999), Derbyshire being a region where customary law was comparatively very strong.
[740] Lead mining is examined in Chapter 5.

awaiting his master's instructions, steward Thomas Colpitts I wrote 'We may then set about to make Trials, and whether we meet with a new Peru, or otherwise, it will at least serve as a Beacon to guide all future Generations from splitting on that rock'.[741] George Bowes granted twenty-two tacks and leases and thirty mines/mining areas were worked – twenty-five at different times by various lessees, eleven by George Bowes, and six by Bowes and partners.

Lead mining on this estate conformed to current practices – gunpowder blasting, and levels and ventilation at the deeper mines, and mechanical stamps for dressing ore – and there was little change in technique or technology, no revolution on the estate. Knowledge was cumulative, geological understanding practical, but neither scientific nor predictive. Similarly, the smelting process was up-to-date, using the ore hearth and slag hearth, preceded by improved washing and dressing. George Bowes instigated managed change in metallurgy producing an improved yield by the late 1750s at the new Wemmergill smelt mill.[742] Lead ore output

was 3,375.25 bing between 1741-59 (a bing = 0.4 ton); smelted pig lead output was 457 fothers 1741-60 (a fother =1.05 tons at Newcastle). Labour productivity and return on capital were variable, determined by the presence of the mineral rather than technique or technology. The analysis of scant data from extant records is inconclusive; only greater Bowes investment would potentially have improved total factor productivity.

The Bowes estate traded locally in lead ore and pig lead, the former being relatively insignificant, whilst direct export was virtually non-existent.[743] Most lead was sold to leading merchants; of the divers merchants specialising in lead, two-

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[741] *D/St/C4/1/3* The reference to Peru indicating, of course, the expectation of discovering silver there.
[742] See Chapter 6.
[743] See Chapter 7.

thirds was sold to Peareth & Sorsbie, who traded with London merchants, and 11% to Ralph Carr. Bowes lead held a minority share of the Newcastle upon Tyne market compared to Blackett-Beaumont lead; George Bowes had no influence over the price of lead, nor was there any association of producers to control it, in contrast to the Bowes' coal business. Bowes' expansion of lead output suffered enforced contraction because of war, particularly that of 1756-63, suppressing lead exports to Europe which were not replaced by increased local or London consumption. Consequently, the Bowes were compelled to stockpile lead, because short-term inelasticity of supply meant producers flooded the Newcastle market causing prices to fall until market equilibrium returned after war.

A Bowes' estate model for lead production was moulded into shape during the period 1740-60. It presents a number of characteristics, some differing from other regional producers, which have implications for proto-industrialisation. Leases created a monopsony of extracted lead ore for the Bowes; they smelted it and supplied pig lead to the Newcastle market, which fed London's consumption and export overseas. The leases encouraged small-scale enterprise by self-employed miners and adventurers, but most working capital – ninety-six per cent – was introduced by the Bowes, often subsidising output. They were also adroit instruments that allowed the Bowes to enter into partnership during the life of a lease when mining potential appeared strong. The organisation of mining was a variant on the types of arrangements for mining known to have existed elsewhere in the North Pennines. There was much variation in the size of tracts, areas of land, granted. Division of labour, specialisation, emerged in the different stages of the production process, some paid by results and some in the form of wages; employment in lead began changing from a secondary source of income controlled by the seasons in the

agrarian system, to a primary source, often on a full-time basis. The estate pay bills evidence skill based roles – miners, smelters, carriers, washers – including some female lead miners and family groups performing different functions.[744] The changing nature of occupations hints at an 'industrious revolution', but the numbers were small in an upland area of very low population density. By 1760, even 1771, this was not an industrial society on the scale described for coal mining Whickham.[745] There were no mining customs or laws: only Bowes' governance.

The role of George Bowes is singular.[746] Until recently seen as an archetypal absentee landowner, MP, and wealthy coal magnate from at least the time when the Grand Alliance was formed, his personal participation in the exploitation of lead alters this assessment. His uniqueness as a landowner lay not in his exploitation of lead, but in his direct personal involvement. So there is no indication before his death in 1760 that he considered either granting a lease to, entering into partnership with, or selling out to a larger enterprise.

George Bowes was a dynamic entrepreneur attempting to develop a lead business as another strand of estate development to further extend his family's spectacular wealth. A member of a national commercial elite, he was a leading light at the forefront of economic and social change in the region. He fits Mingay's definition 'of the squire-merchant-industrialist, the composite entrepreneur who played so great a part in developing such areas as Cumberland and Durham and Northumberland in the eighteenth century'.[747] He ventured to change a rural, organic industry on his estate

into an organised and potentially profitable business. In doing so he faced a number of

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[744] See Chapter 5
[745] D. Levine & K. Wrightson, *The Making of an Industrial Society: Whickham 1560-1765* (Oxford 1991) p. 76.
[746] His significant determining role is discussed in Chapter 8.
[747] Mingay, *Gentry*, p.100.

challenges: lead mining because of its nature was riskier than coal mining; there was a lack of infrastructure in the landscape, only packhorse roads existed; the control of property rights in relation to estate development, appropriate letting arrangements were required; the extent of capital investment required assessment, because lead mining was risky; the effectiveness of the management system, an inherited structure without speiclist roles for lead; and market conditions, which were controlled by the variables of transport costs and possible disruption. George Bowes understood the nature of the lead trade: that production was responsive to the selling price of pig lead; that restrictions on overseas trade, especially war, could cause price volatility; and that if trade was hampered, even temporarily, price falls could prove disastrous.

He was a strategist, and alongside his stewards also managed each stage of his estates' lead business, and thereby transformed it from inert to active. Strategically he moved the estate from active, direct exploitation of lead in the 1740s, to largely passive management in the early1750s, with renewed direct interest from 1756, all in response to learned market mechanisms. The Bowes commitment to lead is confirmed by expenditure of £4,869 on lead mining alone during 1731-58, whilst that of the previous century amounted to less than £200. George Bowes introduced most of the working capital, but during the 1750s actively encouraged, through leases, exogenous investment, though small-scale, from both local sources and other lead regions, such as Yorkshire and Derbyshire.[748] This was hardly a rush for grey gold, but

indicates recognition of the Bowes estate's lead potential at a stage when it appeared as the final frontier of lead mining in the North Pennines. Furthermore, his use of leases was a direct incentive for small-scale enterprise in the extractive economy.

George Bowes found no necessity for technological change, because

[748] See Chapter 8.

his estates's production structure was of a small-scale nature. Instead he increased activity within the bounds of existing technology, and in doing so revealed exceptional knowledge of a metalliferous process. He focused on improving pig lead yield, and by managing the disciplined work rate and key skill of smelters was responsible for more efficient metallurgy and ultimately greater productivity. Similarly, he micro-managed washing and dressing which directly affected ore quality for smelting, and the labour force in terms of remuneration and accommodation in an upland wilderness environment.

Compared to his predecessors, George Bowes was innovative in two ways: he directed change in the structure and organisation of the production process; and he recruited specialist stewards for mining and smelting and encouraged the poaching of reputable smelters and carriers from nearby families with lead interests, like the Vanes of Raby Castle. He understood that progress in change would be restricted without the installation of these stewards; coordinated patriarchalism was at the core of the Bowes firm.

George Bowes was eager to market his lead and acted as merchant in Newcastle during the summer months of the 1740s, coordinating the output, movement, and delivery of lead. The crucial variable factor in general viability and profit margin was the cost of transporting both lead ore and pig lead. Consequently, George Bowes was confronted, in the absence of infrastructure, by the spatial problem of smelt mill location, and the logistical one of routes and distances and capabilities of packhorse carriers. Suffice to say he resolved both; in 1756 he decided – based upon power, fuel, and roads – to relocate smelting nearer the mines, and chose the northerly route to the Newcastle nexus rather than the easterly one to Stockton. By 1758 overall carriage costs were reduced by 13%, and for bulkier ore alone by almost

50%. Consequently, Bowes lead was supplied to Newcastle manufacturers and the London market more profitably.[749] Lastly, George Bowes continued his family's practice of occasionally conducting lead business in London. For example, in 1749 he dealt with the Earl of Carlisle regarding their partnership problems at Crinkle How mine on the Bowes estate, and there are financial records disclosing transactions between Bowes, the Blacketts, and the London Lead Company, relating to lead business in the northeast.[750]

George Bowes' patriarchal estate management wrought several changes: improved organisation and structure, including a level of capital formation; more extensive mining activity; improvement in metallurgy; and innovation in estate management. Whereas many other landowners deputed or delegated to their stewards thereby creating the circumstances that facilitated their absence, his role contradicts any notion of mineral lord absenteeism; he was the progenitor of an estate industry that came to full fruition after his death, a 'composite entrepreneur',[751] and a capitalist working to control demand and supply of lead ore and smelted lead.

Unfortunately, although he was the first directly involved family member since his sixteenth century predecessors, the Bowes estate's overall position in the northeast lead industry was comparatively insignificant. Its mineral endowment was underdeveloped, and remained so until after 1800. In so far as its lead business remained marginal, the argument that the Bowes estate management system was productive and effective in a similar way to coal, because of its structure and use of accounting practices is proven specious by this analysis.

As has been shown in Chapter 8, even after George Bowes' outstanding

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749 See Chapters 7 and 8.
750 See Chapter 8.
751 Mingay, *Gentry*, p.100.

involvement and commitment to lead production, it cannot be described as a profitable estate business activity, which raises the question – what was his motivation for developing a lead enterprise? Already in 1735 his profit from coal as a member of the Grand alliance was £9,778; in 1736 it was £10,588; and for the ten month period 1st March to 31st December 1738 it was £13,057.[752] A range of possible impelling forces can only be suggested at this juncture. George Bowes may have enjoyed the competition with regional lead producers, because it was a different market to that for coal, in that there was no target market, and consequently there was no cartel. The evidence for the 1740s in particular indicates a genuine anticipation that the estate was a potential source of profitable lead production, and possibly silver too. There again, estate rental income may have been suffering arrears problems during the mid-eighteenth century and Bowes, as beneficent patriarch, expanded small-scale lead output in order to occupy inhabitants who could earn and pay rent. The estate, with its monopsony, was the source of cash payments, but enjoyed the profit margin at market. Whatever motivated George Bowes in his lead business, he did not financially expose the family estate to any real risk, because its wealth from coal could easily have provided the working capital for the exploitation of lead.

The Bowes lead pocket was at the margin amongst a cluster of organisations specialising in the extraction of lead in a region largely characterised by large-scale investment and long-term strategy. George Bowes' efforts were restricted to multiple small-scale operations requiring little capital, unlike coal, avoiding the risk of greater capital input for deeper mining. Consequently, the pace of industrialisation on the estate was relatively slow, demonstrating a variation in the development of lead production within the northeast. Yet he made progress by creating the beginnings of

[752] *D/St/B1/6/96 & 97 and D/St/B1/2143/2 & 3*.

an industrial environment in a fundamentally agrarian setting. Lead production on the Bowes estate in the mid-eighteenth century provides a strong example of proto-industrialisation, and in a regional context contributed, albeit on a smaller scale and a slower pace, to the process of industrialisation.[753]

The findings of this thesis also contribute to several wider debates: proto-

industrialisation; the role of the landowner as entrepreneur; the role of the estate

steward; family capitalism; and the nature of the relationship between the regions and

London.

The extractive industries, regardless of the commodity involved, are rarely –

if ever – presented by historians as an example of proto-industrialisation.[754] Proto-

industrialisation is a model adopted by some historians to understand industry in the

[753] For further discussion see P. Hudson, *Regions and Industries: Perspectives on the Industrial Revolution* (Cambridge 1989), and J.F. Wilson & A. Popp, *Industrial Clusters and Regional Business Networks in England, 1750-1970* (Ashgate 2003) ch.1.

[754] For example, see P.Kriedte, H. Medick, and J. Schlumbohm, *Industrialization before Industrialization* (Cambridge 1981).

countryside during the late seventeenth and eighteenth centuries that supplied

regional and overseas markets. Its characteristics are low capitalisation and a paid

labour force usually consisting of two-job individuals such as farmer-miners, and so

proto-industrialisation is a stage of change before larger capitalisation, factories, and

largely wage based labour force generally accepted as industrialisation. Bowes lead

production in the late sixteenth and mid-eighteenth centuries offers a prime example

of a product generated by small-scale rurally located industry which was delivered to local, national, and international markets. The Bowes exploitation of lead was characterised by comparatively low capitalisation, improvements in productivity within the parameters of existing technology and technique, and a growing division of labour with some evidence of women in the mines and ore preparation. By organising the extraction, preparation, carriage, smelting, and marketing of lead George Bowes initiated a process of change; the transition from an agrarian to a mixed economy on the periphery of a family estate and at the frontier of an otherwise established lead producing region. The Bowes case should assist the promotion of the lead industry into the group of industries currently preferred for analysis when discussing proto-industrialisation, whilst suggesting that the beginning of the usual

time frame is extended backwards to the late sixteenth century. It is clear that by 1771 lead production on the Bowes estate was not full-grown, but that a hybrid form of proto-industrial and industrial production existed there, for example at Isabell-mea-Hill lead mine in the 1740s where the workforce were paid, dedicated lead miners.

During both the late sixteenth century and the mid-eighteenth century the Bowes lead business was driven by the entrepreneurship of particular patriarchs; Sir George followed by his son Sir William before 1611, and George Bowes between 1740 and 1760. The nature of this entrepreneurship changed across the period examined in this thesis. From the 1570s until 1611 the Bowes actively managed lead under the terms of leases; their Teesdale estate was only passively managed using a very limited number of leases between the 1670s and 1710s. George Bowes, motivated by the prospect of profit introduced an active, vigorous style of management after 1740.

Under the direction of George Bowes the inherited estate management system experienced the innovative introduction of specialist stewards to develop lead production. The Bowes estate lead, regardless of its comparatively small output between 1740 and 1771, can be identified as being amongst those estates that were structured for the serious exploitation of lead.[755] The significance of the steward's role is re-emphasised by this case study, and gives some indication of this niche role in estate management with its direct influence on industrialisation. It is worth re-stating here that the mining lease emerged as perhaps the most significant tool of Bowes' estate management.

The Bowes estate operated as a firm based upon gentry entrepreneurship. It is

[755] See Chapter 5.

an example of family capitalism, and the extent of the financial commitment has already been noted. It is clear that George Bowes invested the appropriate level of working capital, as well as subsidising some mining lessees and 'putting in' tools and equipment. There were incentives for small-scale enterprise, including the granting of leases to adventurers from outside the region willing to invest in mining. Essentially, the Bowes use of the mining lease captured output on the estate and controlled market supply. Yet the Bowes' persistence with lead at times when either geology or adverse market circumstances determined poor returns rather suggests that even during the mid-eighteenth century there was an underlying paternalism, a desire to sustain, subsidise if necessary, industrialisation for the benefit of estate inhabitants. Alternatively, the Bowes may have ensured long term social stability for the profitability of lead and the security of rental income from estate tenants capable of earning from mining, ore preparation, lead carriage, and smelting. Ultimately, self-interest appears to have been at the core of George Bowes' strategy for the family estate.

London was the lead staple throughout the period; the city-port was the main domestic consumer and gateway to foreign markets. The Bowes lead enterprise of the late sixteenth century reveals the financial nature of the northeast's relationship with London as a source of merchant capital for lead mining enterprise, in contrast to coal mining.[756] This regional-capitol axis continued, but the mechanism had

changed by the mid-eighteenth century; the Bowes estate no longer required occasional injections of capital – they had enormous wealth from coal – and sold its lead to Newcastle merchants who supplied larger London merchant houses.

[756] J.U. Nef, *The Rise of the British Coal Industry* (London 1932 and 1966) Vol. I pp. 356-358, and Hatcher, *British Coal*, ch. 7, show that Newcastle merchants and local gentry were the main source.

Lastly, to what extent did the Bowes estate's management of lead exploitation contribute to creating a defining context for industrialisation on the northeastern periphery? This case study draws lead production somewhat further out of the shadows of larger scale industries generally granted by historians a greater strategic role in the process of industrialisation during the early modern period. The Bowes family provides an example of gentry entrepreneurship during the late sixteenth and mid- eighteenth centuries, revealing its role in the economics of lead mining, smelting, and marketing, and the consequences for the inhabitants and workforce of an upland estate. During the late sixteenth century, the Bowes experienced the good fortune of occupying an institutionalised role, as Moormasters, through the lead mines lease granted by the Bishop of Durham; they were active managers of a lead business outside their lands which required little entrepreneurial creativity. Whereas, in the mid-eighteenth century, George Bowes began with a blank canvas and directed change for gain. Clearly, therefore, most of the answer as to the extent of a contribution to creating a context for industrialisation lies in period of his patriarchy.

A fixed lead mining zone was established; it was close to a cheap, abundantly available fuel, peat, so consequently the transportation of coal was not a problem in a region lacking infrastructure. Change was wrought within existing technology and technique; the coal-fired reverberatory furnace for smelting was unnecessary at this stage. The yield of pig lead from ore was, however, increased through a managed improvement in metallurgy, and this smelted lead contributed to the regional market, particularly Newcastle's consumption, and indirectly the London staple.

Bowes encouraged small-scale capitalist enterprise appropriate to the higher level of risk incurred in lead mining. Fundamental to attracting adventurers and miners was the level of security offered in property rights, which benefited both

them and the Bowes estate. This process was controlled through the institution of the mining lease, which was strictly in favour of the Bowes, yet a comparatively flexible management tool. The required change in the organisation of lead production demanded different management; this was achieved by introducing specialist stewards to the inherited system who enforced the leases. Capital from merchants within the northeast and other lead mining regions such as Derbyshire, Lancashire and Westmoreland, and Yorkshire was gradually attracted by the nature of the Bowes leases. Most capital was working capital invested by the Bowes, but a level of capital formation accrued in the form of underground systems of shafts and levels which facilitated the continuation of mining.

The organisation of the production process – mining, washing and dressing, smelting, transport, and marketing – was generally effective in reducing costs and thereby improving viability. In particular, the reduction of ore and pig lead carriage costs were very important for profitability in fluctuating market conditions. Improved organisation led gradually to the division of labour and skills at different stages in the production process, and these were different to the usual agrarian occupations. The development of an extractive industry meant the continued existence of a secondary occupation and source of income for some, and a full-time occupation for others on the estate regardless of the season. The movement towards occupational and income change perhaps maintained a balance in the estate's economy by supporting the payment of rents otherwise unaffordable.

Overall, this case study of the Bowes estates increases our knowledge of the British lead industry, particularly in the northeast during the mid-eighteenth century. Although the nature of Bowes entrepreneurship changed over two centuries,

it was the catalyst in lead production that wrought change through the process of industrialisation, because a ‘stage’ of growth was achieved, though lead production on the Bowes estate was late in developing. Moreover, George Bowes’ personal involvement is a rare example of the gentleman landowner playing a direct role in the exploitation of the family estate. Lead extraction and manufacture did create the context for industrialisation on the Bowes estate, contributing to this industry’s expansion in the northeast.

Appendix 1

Lead ore production by mine 1741-60 (in bings, horses, and pokes)

		Bings	*horses*	*pokes*	
Arngill	**1741**	**6**	**2**	**0**	
	1742	6	2	0	
	1746	23	0	0	
	1757	56	2	0	
	1758	56	2	0	
Black Ark	1757	21	1	2	
Black Sike	**1748**	**18**	**0**	**0**	
	1757	0	2	0	
Closehouse	**1751/2**	**140**	**2**	**0**	
	1753/4	11	1	0	
	1755	20	0	0	
	1757	148	2	0	
	1758	83	1	0	
	1759	14	0	0	
Cock Lake	1758	0	2	1	
	1759	0	1	0	
Crinkle How	**no data**				
Dodd Hill	1741	15	1	0	(bought in)
Green Mines	**1751/2**	**35**	**0**	**0**	
Isabell-mea-Hill/ Birkdale	1741	465	3	0	
	1742	556	2	0	
	1743	331	2	0	
	1744	221	2	0	
	1745	98	0	0	
	1746	80	1	0	
	1752/3	90	0	0	
	1754/5	80	0	0	
	1755/6	88	0	0	
	1757	108	3	1	
	1758	27	1	1	
	1759	2	0	0	

Appendix 1 (continued)

Lunehead	1741	3	1	0	
	1743	7	0	0	
	1746	36	0	0	
	1757	214	1	1	
	1758	80	1	0	
	1759	13	2	0	
Nichol Hopple Yard	no data				
Pikelaw	1743	8	1	0	(bought in)
Rowton Sike	1754/5	50	0	0	
	1758	20	3	1	
	1759	2	1	½	
Standards	1741	23	2	0	
	1742	23	0	0	
	1743	3	0	0	
	1746	37	0	2	
	1757	58	2	0	
	1758	31	2	0	

Sources:

D/St/B2/157; D/St/B2/22; D/St/B2/127; and *D/St/B2/108*

Notes:

1. Standards 1743 is duty ore
2. Isabell-mea-Hill 1752-1756 was accounted for December-to-December. This mine also became known as Birkdale from the mid-1750s.
3. Green Mines 1752 was accounted for December to December
4. Closehouse 1752 included nearby Thringarth
5. Arngill 1755 includes nearby Wemmergill
6. Rowton Sike 1754/5 was accounted for June to June

Appendix 2

Bowes Estate Mines Expenditure 1731-58 (excluding carriage and smelting)

Mine		*£*	*s*	*d*
Arngill	1757	37	7	1
	1758	10	0	0
Black Ark	1757	50	12	4½
Black Sike	1747	71	17	10½
	1748/9	27	18	0
Closehouse	1731	8	3	1
Crinkle How	1748/9	97	8	2
Cronkley	1741	29	10	0
Green Mines	1741	3	9	2
	1751/2	114	2	6
	1754/5	13	12	0
Isabell-mea Hill/	1741	340	6	10½
Birkdale	1752/3	73	6	5
	1754/5	125	14	6
	1755/6	164	9	10¾
	1757	118	10	5½
	1758	164	9	10
Isabell-mea-Hill/ **Arngill/Standards**	1741	602	2	7½
Little Street	**1753/4**	**4**	**19**	**4**
Lunehead	1739	351	0	11
	1757	56	10	0
Nichol Hopple Yard	1741	11	2	0
Rowton Sike	1752/3	75	15	6
	1757	109	3	8½
	1758	171	1	1
Side Lead Mine	1754/5	37	18	0

Appendix (continued)

Silverkellwell	1758	4	19	8
Standards	1737	12	19	7
	1758	28	8	0

Source:

D/St/B2/102-122, and *D/St/C2/3/76* for 1758 only.

Notes:

1. Closehouse 1751/52 includes the nearby workings at Thringarth.
2. Isabell-mea-Hill 1752/3 onwards was accounted for December to December.
3. Rowton Sike was accounted for December to December
4. Generally, the estate records for mining expenditure are not itemised in detail, Isabell-mea-Hill accounts for the 1740s being the exception. The mines' pay bills provide most details of expenditure.

Appendix 3

Table I

Sales of Bowes pig lead (smelted lead) to various Newcastle purchasers 1741-46

	Purchaser	*Pieces*	*Price/Fother* £ - s	*Weight* Fthrs	cwt	qtrs	lbs
1741	'Several accounts'	139		8	15	3	7
	Peareth & Sorsbie	50	11-15	3	9	2	14
1742	'Sold at mill'	1			1	1	14
	Ralph Harle	50	12-15	3	10	0	7
	Surtees & Atkinson	60	11 & 11-15	4	4	1	14
	John Lanet	100		6	19	2	0
	Ralph Carr	349		24	9	0	7
1743	Peareth & Sorsbie	2000	11 & 11-10	142	4	0	7
	Surtees & Atkinson	122	10-15, 11, & 12	8	13	1	14
	Henry Morgan	1			1	1	21
	Reah & Wilkinson	40	12	2	17	2	0
1744	Reah & Wilkinson	140	several	10	0	2	14
	Isaac Cookson & Co.	52		3	12	0	14
	Lionel Dixon	40	12	2	17	1	21
1745	Surtees & Atkinson	62		4	7	3	4
	miscellaneous	1		0	1	1	17
1746	Surtees & Atkinson	30	11-5	2	1	2	14

Source:

D/St/B2/105, D/St/B2/147, D/St/B1/20/68

Notes:

1. The numbers of pieces of lead (pigs), weights, and prices have been taken directly from the records examined.
2. In 1742 Surtees & Atkinson bought 30 pieces at £11 15s and 30 at £11.
3. In 1743 Peareth & Sorsbie bought 1000 pieces at £11 and 1000 at £11 10s. Surtees & Atkinson bought 30 pieces at £10 15s, 30 at £11, and 62 at £12.

Appendix 3

Table II

Value of pig lead sales by purchaser at various prices 1741-46

	Purchaser	*Pieces*	*Value*		
			£	s	d
1741	'Several accounts'	139	118	7	10
	Peareth & Sorsbie	50	38	9	1
1742	'Sold at mill'	1		17	0
	Ralph Harle	50	42	10	10
	Surtees & Atkinson	60			
	John Lanet	100	84	9	11
	Ralph Carr	349	256	3	0
1743	Peareth & Sorsbie	2000	1599	14	2
	Surtees & Atkinson	122	45	15	7
	Henry Morgan	1		16	6
	Reah & Wilkinson	40	34	0	0
1744	Reah & Wilkinson	140	116	0	2½
	Isaac Cookson & Co.	52	39	7	0
	Lionel Dixon	40	32	16	6
1745	Surtees & Atkinson	62	47	1	6
	miscellaneous	1		16	6
1746	Surtees & Atkinson	30	22	5	9½

Source:

Appendix 3, Table I.

Notes:

1. Values for 1743 have been estimated using the known price per fother derived from cited records.

Appendix 4

A lead mine lease of 25th September 1740

Whereas John Dent of Dufton in Westmoreland Yeoman hath this day made a Discovery for George Bowes Esq. of Leadmines and Lead Oar being and remaining at a certain place called Isabel mae hill in the parish of Romaldkirk in the County of York. The said George Bowes in Consideration thereof has hereafter agreed that the said John Dent shall have and Enjoy one fourth Share of such Leadmines and Lead Oar to be gott at the place aforesaid for a Tenure of seven years first Deducting Every sixth Bing of lode washed and merchantable oar And the Bounds and Limitts of the said Leadmine to Contain from the first founder Shaft Eight Hundred Yards in Length and two Hundred yards in breadth. And the said John Dent hereby agreed from time to time to pay a fourth part or Share of all said expenses as shall be Expended and Laid out in his winning and working of the said Leadmines as well for working of the Sixth Bing first to be delivered and aforesaid and also for all other Charges and Expenses to be laid out for the working of all other parts and Shares herein. And the said John Dent hereby agrees that he will not at any time during the said Term hereby intended to be Demised Lett or otherwise Dispose of any part or share of such fourth part or share (after deducting very Sixth Bing aforesaid) to any person or persons whatsoeverwise Lease in writing first had from the said Mr. Bowes. And that Mr. Bowes Shall have the Direction and Disposal of all such Lead Oar as shall from time to time be wrought and arise from such fourth part or Shares above agreed to be for the said John Dent and the same to be Carried to such places to be Smelted Refined and so forth as he this said Mr. Bowes shall order and not otherwise. And witness our hands this day and year above written

Witness

Ro. Shafto G. Bowes signature

Ferrer Wren John Dent signature

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