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MECHANISATION AND THE MINER: WORK, SAFETY AND LABOUR RELATIONS IN THE SCOTTISH COAL INDUSTRY, c, 1890-1939.

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PREFACE

I would like to acknowledge the assistance that I received during the course of this thesis. In particular I would like to thank the staffs of the National Library of Scotland, the Scottish Records Office (West Register House), the business records section of Glasgow University Archives, the Andersonian Library at the University of Strathclyde, and last but by no means least I am very grateful to the staff of the Mitchell Library Glasgow who, like miners themselves, unearthed the many copies of the *Colliery Guardian* consulted throughout the course of this research. Furthermore, I would like to take this opportunity to thank my supervisor, Dr. Arthur McIvor for all the help, guidance and patience accorded me during the course of this project. Finally, and most importantly, to my wife and family for their long sufferance whilst I have been engaged in this work. Needless to say, any errors in the thesis are entirely my own responsibility.

Sandy Renfrew

ABSTRACT OF THESIS

TITLE: MECHANISATION AND THE MINER: WORK, SAFETY AND LABOUR RELATIONS IN THE SCOTTISH COAL INDUSTRY, C. 1890-1939.

The aim of this research is to fill the gap in the current historiography of the labour process and industrial relations on the impact of new technology on the work process. Invariably, when considering mechanisation in the coal industry, the existing literature usually glosses over the topic referring to the numbers of machines in use and the percentage of output produced. Little in-depth research has been undertaken into the way these new processes changed the work of the miner, the effect on safety undergroundand the effects that these innovations had on labour relations in the industry.

The thesis probes the way mechanisation affected the work of the miner. Consideration is given to deskilling, loss of control at the point of production, intensification of the work process and employment. The findings show that although some mineworkers increased their skills the vast majority experienced a downgrading in skill. Employers used new technology to erode the control miners had in the mines. Mechanisation led to an intensification of work effort. Mechanisation proved a doubled-edged sword for employment opportunities. Employment increased in the earlier period, but the move to mechanical conveying in the inter-war years had the opposite effect on job opportunities. Regarding mine safety the evidence indicates that mechanisation led to an increase in the risk of death and injury for Scottish mineworkers. New technology also impacted on industrial relations. Mines, which were highly mechanised generally witnessed a high degree of industrial unrest. It is not suggested that mechanisation was a direct cause of conflict but it has been demonstrated that it did produce potential grievances which may have been translated into industrial conflict.

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Abbreviations used in text and notes:

AMU	Ayrshire Miners' Union.
BJIR	British Journal of Industrial Relations.
BJS	British Journal of Sociology.
EHR	Economic History Review.
FKMA	Fife and Kinross Miners' Association.
GUA	Glasgow University Archives.
IRSH	International Review of Social History.
JEH	Journal of Economic History.
LCMA	Lanarkshire Coal Masters' Association.
LICC	Lochgelly Iron and Coal Company.
LMCU	Lanarkshire Miners' County Union.
MAGB	Mining Association of Great Britain.
MELMA	Mid and East Lothian Miners' Association.
MFGB	Miners Federation of Great Britain.
MLG	Mitchell Library, Glasgow.
NLS	National Library of Scotland.
NUSMW	National Union of Scottish Mine Workers.
SMF	Scottish Miners' Federation.
SRA	Strathclyde Regional Archives.
SRO	Scottish Records Office, West Register House.
SSLH	Society for the Study of Labour History.
SUA	Strathclyde University Archives.

Unless otherwise stated, place of publication of works cited is London.

Mechanisation and the Miner:
Work, Safety, and Labour Relations, The Scottish Mining Industry, c.1890-1939

Introduction[1]

It has been said that the mechanisation of mining methods would revolutionise the work of miners in a very positive way. New technology would result in miners becoming skilled artisans who would work in surroundings which were both more congenial and less dangerous.[2] In other words, work would become less arduous and burdensome, it would be carried out under conditions whereby the safety of colliers was much improved and the people engaged in the task of winning coal would be of enhanced status. Counter arguments exist. For instance, technological change in Scottish coal production resulted in much more intensified work which was performed in highly dangerous surroundings by workmen who had been reduced to little more than manual labourers.[3] Taking another tack it has been argued that the presence of strong labour organisations posed such a formidable threat to change in industry that businessmen in Britain were forced to postpone or abandon the introduction of new technology.[4] The strength of trade unions was such that management was unable to gain control in the workplace and, thus were unable to utilise the latest technology which helps explain, as argued by Elbaum and Lazonick, Britain's inability to compete effectively with her rivals.[5] If this was true across the British economy did obdurate Scottish minerworkers impede technical progress within their industry? Again evidence to the contrary exists. Indeed, it was the opinion of one government official that much of the success of modernisation within the Scottish coal sector was due to the positive attitude shown by colliers to changing work systems and methods.[6] It can be seen that controversy exists on the relationship between the introduction of new technology and work, safety conditions and labour relations of industrial workers.

The aim of this thesis is to explore these relationships in some depth through an investigation of the Scottish mining industry during the period 1890-1939. The Scottish coal industry witnessed a pronounced move to mechanised methods of coal extraction in this era. The speed and extent of diffusion of new technology was much more rapid in the Scottish mining districts than it was in the rest of the British coalfields. Thus the choice of industry and time period are justified in the attempt to test these theories. Furthermore, the mining industry was one of the most strike prone of all of Britain's industries. The turbulent record of industrial unrest in the coal industry underlines the existence of strong labour organisations which again validates the choice of this sector for investigation. Contemporary criticism by coalowners of labour obstructiveness and the findings of the 'Reid Report', 1944/45, point to opposition from labour to the introduction of new working methods and processes which imply a struggle for control at the point of production. J H Goldthorpe has argued that the growth in the use of intensive mining techniques resulted in deteriorating industrial relations within the coal industry. The move to mechanised extraction meant increased supervision and the intensification of the work process. This coupled with the possibility of the downgrading of mineworkers due to the deskilling effect of new technology may well have led to acrimonious labour relations. Whether this was the case in Scotland merits intensive analysis.

Little recent reseach has been done on Scottish mineworkers during this period. The last extensive study was Page-Arnot's history of the Scottish miners written in the 1950s.[7] Despite being somewhat dated and, remembering that it was written for the miners, it is still a useful secondary source. Unfortunately, there is nothing in the existing literature dealing with this period to match A Campbell's comprehensive study of the Lanarkshire miners during the eighteenth and nineteenth centuries.[8] This is not to say that research on the coal industry has been neglected in recent times. However, the vast majority of such work is orientated to the British industry and focuses on economic rather than social concerns. Nevertheless, much of this has proved extremely useful in gaining an understanding of the economics of coal production. The work by Griffin and Kirby, for example, provides a good insight into the problems faced by coal producers during the period of this study. However, these studies are of little help in understanding the relationship between mechanisation and the work of the miner. Griffin's two main studies adopt a similar approach when tackling the diffusion of machine technology within the industry. That is, he provides a 'shopping list' of dates when the main inventions were first introduced. In common with much of the available material he cites data showing the percentage of coal cut and transported by machine at various times throughout the period.[9] Griffin does highlight some of the technical difficulties associated with machine-cut coal, for instance the need for increased and improved cleaning facilities to cope with increased dirt levels which were a consequence of machine-mined coal.[10] This author also adopts a well used and erroneous[11] explanation for Scotland's early technological lead stressing that geological conditions - that thin seams and diminishing returns were the main reason behind the earlier adoption of coal-cutting machinery by Scottish coal masters.[12] Kirby, in a similar vein, cites statistics on percentage of mines using cutters and output produced but he does touch on the possibility that new technology in mining led to labour relations problems within the industry.[13]

The two most recent and comprehensive studies of the British coal industry covering the period of this study are by Church and Supple.[14] Both works provide extensive and intensive coverage of the industry during their respective time periods. These volumes were invaluable in gaining a thorough understanding of one of Britain's greatest industries. Both authors engage the question of modernisation of coal mining. Church, understandably, emphasises technical changes such as improved winding and ventilation which made the greatest impact during his period of study. However, he also deals with the introduction of machine cutting and conveying. On the question of labour opposition to technological change he argues that perhaps too much has been made of this allegation, although he does make reference to Wm. Baird Ltd., abandoning coal cutters in 1894 owing to opposition from mine labour.[15] Church makes an interesting point with regard to the level of mechanisation. He posits the view that too much attention has been given to the 'lack' of mechanisation before 1914. By his calculations 62-72 percent of coal in Britain, due to geological reasons was unsuitable for machine mining. That is, seams were greater than 4 feet high, or they were steep and faulted, or mines contained soft easily worked coal - like the South Wales field.[16] As will be shown in chapter one, the most highly mechanised area in Scotland were the developing fields in the east where seams of 4 feet and more were worked by machine.[17] Also regarding the South Wales coal field it should be noted that this was one area where conveyors were employed extensively. It would seem then that there was more scope for the utilisation of mechanised mining than Church appreciates.

The Supple volume in this NCB project has proved equally as valuable as that of Church. Dealing mainly with the inter-war years more time has been devoted to the machine question. Supple touches upon the main themes tackled in this thesis - the impact of mechanisation on work, safety and labour relations in the mines. Admittedly, owing to the scope of his book the treatment of these issues is limited. He does, however, argue that the introduction of new technology to mining resulted in de-skilling, loss of autonomy, increased supervision and intensification of the work process.[18] He states that the introduction of mechanisation resulted in 'a degree of antipathy to new methods, a latent culture of anger and even occasional acts of sabotage'.[19] However, little evidence is given in support of these theories. This is a very important point and deserves further in-depth analysis. The complicated relationship between labour and new technology is scrutinised in Chapter five, in an effort to redress this imbalance.

The treatment of mechanisation through statistics of tonnage cut and so forth is also common in the general Scottish economic histories. Slaven's book on the west of Scotland takes this line showing, for example, that in 1913, 500 machines were at work in the western coal fields producing more than half of the region's output.[20] Being general histories the coverage afforded to individual industries is scant. Slaven only devotes three pages to the coal industry for the period covering 1870-1960. A similar situation is encountered in Lenman's economic history of Scotland were just over a page is devoted to the industry during the years 1840-1914.[21] Marwick's earlier work also provides a 'whistle-stop tour' which is of little use to this study.[22] R Campbell's work, which is helpful on the economy of the Scottish coal industry, is of less value dealing with the impact of new cutting methods on work in the pits. In his book dealing with the rise of an industrial society no mention of mechanisation is found in the period to 1914. On the inter-war era reference is made to the lead shown by

Scottish coal producers regarding mechanised production.[23] His other main work on Scottish industry[24] is exemplary in providing an understanding of the economic position of the industry but makes little reference to mechanisation. This being the case and taking cognizance that no other in-depth study on the relationship between the introduction of new technology and work in Scottish mining has been traced once more underlines the gap in the present historiography.

As so little work has been carried out on this topic much use was made of official sources. The mine industry is one which has generated a plethora of government inquiries, commissions and annual reports. This material has proved invaluable, particularly with regard to the relationship between mechanisation and safety. Very little research has been done on the technology, health and safety interface in the British historiography. Nothing has been traced which compares to Whiteside's exceptional, wide-ranging study of the American mining industry and mine safety.[25] Consequently, official sources and contemporary secondary material have been analysed to elucidate this area. The annual reports of the mines inspectors provided an abundance of factual material which help illustrate the complex relationship between mechanisation and mine safety. This was supplemented with data from various inquiries with the Royal Commission on Safety in the Mines, 1938 and the Report of the Miners' Eight Hour Day Committee, 1907 proving especially useful. Contemporary secondary sources such as the works by Barrett-Brown, Coombes, Heinemann and Jones were also helpful.[26]

To gain an insight into the labour process and organisation of the work of the miner various technical literature was consulted. Among the works utilised were Hyslop, Percy and Williams.[27] However, the most informative, by far, was Kerr's *Practical Coal Mining*.[28] The *Colliery Guardian*, a weekly publication covering all aspects of the coal industry, proved to be of immense value, not only in respect of technical papers, but also on such issues as the state of trade, safety, labour relations and work of the miner.[29]

Various depositories in Scotland house immense selections of business and union records which have been extensively consulted throughout this thesis. The National Library of Scotland contains records of all the mining trade unions of the era. The Mitchell Library in Glasgow contains a full run of records for the Miners' Federation of Great Britain and an incomplete set of annual reports and executive minutes of the Lanarkshire Miners' County Union. The value of such records in connection with this investigation was usually extremely good. For instance, records of the LMCU, the Ayrshire Miners' Union and the Fife and Kinross Miners' Association contain a wealth of useful material on the interaction between mechanisation and work, safety and labour relations. The records of the Mid and East Lothian Miners Association were of less value as they rarely touch on topics such as machine mining, safety, or even labour disputes, dwelling more on the inter-union rivalry of the time. Business records of many of the main Scottish coal companies are also extant. The business records section of Glasgow University Archives, the Scottish Records Office (West Register House, Edinburgh) and Strathclyde University Library being the main repositories. Again such records proved useful in varying degrees. The records of Wm. Bairds tended to concentrate on the metallurgical side of their business, although they do contain ample material on the modernisation of their holdings in the Ayrshire coal field. Records of the Lochgelly Iron and Coal Company proved the most detailed in connection with the modernisation of their mines, with much detail included on their mechanisation programme.

Access to such an abundant supply of source material was vital to the completion of this project but problems with sources were encountered. When dealing with a regional study obstacles are met when attempting to build county by county statistics for inter-county and Scottish-British comparisons. In most published material the Scottish figures are subsumed within British statistics. This necessitated a trawl of the annual reports of the Mines Inspectorate, for instance, to build up a picture of the level of mechanisation, electrification, employment and output for the individual Scottish districts. The availability of such data being fundamental for this type of study. However, even this proved less straight forward than might be assumed. With regard to the level of mechanisation, for example, differences in the way statistics were compiled proved problematic. In the earlier years inconsistencies were found in the way mines engaged in machine mining were recorded. Until 1910 Scotland was divided into two distinct mining areas - the eastern and western districts. While the inspector of the eastern field noted which mines in his district used coal cutters[30] his counterpart in the west did not. Thus for the earlier years of the study data is available for the eastern counties alone. On amalgamation of the districts in 1910 the style adopted by the eastern inspector became the norm.

Another difficulty was that a full run of the List of Mines has not been traced. However, those that are extant have proved sufficient for making comparisons throughout the period of study, using additional material from the Mines Inspectorate, for instance to support the known data. Statistical techniques have also been employed to extend the known data. One instance being the micro-study of three mines of the Wemyss Coal Company in connection with injury rates and mechanisation. The accident books of this company survive for the years 1907-1926. The annual accident figures were calculated for three mines at various stages of mechanisation in an attempt to establish whether a link existed between machine mining and injury rates. In order to do this one has to establish an accident rate per worker, in this case per 1,000 workers. If just the numbers of accidents are used then a misleading picture can be formed as one pit might employ a much greater number of workers thus distorting the data. To counteract this the known data on employment levels was used to extrapolate data on numbers employed so that injury rates for most of the years could be compiled. While acknowledging that problems exist with this type of statistical exercise it is justifiable as it permits a comparison of trends in accidents at the different pits to be made. This in turn permits conclusions to be reached on the interaction between mechanisation and safety of mineworkers.

The geographical districts were changed a number of times during this period. As noted, the Scottish divisions were merely amalgamated thus a simple totalling of the data before 1910 is all that is necessary. When dealing with districts in England and Wales one confronts greater difficulties. Several regions within designated districts were transferred to completely different areas making comparisons over time difficult. Such problems can be surmounted, albeit requiring accurate and painstaking extraction of data from individual annual reports.

The method of recording accidents also changed from 1914. Prior to that date very full and complete information on accidents, fatal and non-fatal, were recorded in the mines inspectorate reports. By cross referencing this with information in the List of Mines it was possible to show which accidents occurred at mines engaged in mechanised production. Unfortunately, this is only possible over a limited time-span, the years 1906 and 1914.[31] Nevertheless, it has been possible to show whether a link exists between mechanisation and safety conditions in Scottish pits.

In chapter one a wide-ranging discourse on the possible advantages and disadvantages of technological change in industry is undertaken. This covers various industries before concentrating more fully on the Scottish mining industry. The main themes of the thesis are laid out, that is, the effect that mechanisation of coal extraction had on the work and workers in the industry, whether modernisation of mining practices proved advantageous or detrimental to the health and safety of Scottish miners and the consequences changed work methods had on labour relations in Scottish pits.

In an effort to set the investigation in context the economic position of the British and Scottish mining industries is analysed in chapter two. To aid clarity and simplify the study the chapter is in three sections. The first two deal with the 1890-1914 period whilst the third examines the inter-war years. Section 1 analyses the economics of coal production in the years prior to the Great War. Areas studied include; employment, output, productivity, prices, markets, foreign competition and the industrial structure of the industry. Much of the discourse on the economics of coal production is centred on the earlier time period. This is justifiable because many of the factors looked at in this era are applicable to the later period.

The second section looks at entrepreneurs in the Scottish coal industry. Although this study is primarily centred on the impact of new technology on workers in the Scottish mining industry some time has to be devoted to the attitudes and actions of those in charge of the industry. To this end case-studies of three leading coal companies and one employers' association have been conducted to probe the relationship between management, mechanisation and labour. The availability of suitable source material has further limited the investigation to the earlier part of the period. This, again, is acceptable because it was during this time period that the companies in question embarked on their modernisation programmes so this should prove the most enlightening period for such research. The company records of each firm have been scrutinised to establish the strategies employed during this modernisation phase and profiles of the level of mechanisation built up using this data and that contained in the List of Mines. The records of the Lanarkshire Coal Masters' Association have been thoroughly researched in an attempt to establish the attitudes and strategies of this body to mechanisation. Thus, some light will be shed on the way the actions of employers and their associations affected mineworkers in the Scottish coal industry.

The third section, coal production in the inter-war years, concentrates on the particular problems faced by the industry during these years; the dislocation of trade resulting from the Great War, increased competition from new coal producers and from new sources of energy and the depression itself. Time is also devoted to the measures, (the Coal Mines Act of 1930 for example) which were adopted to try and combat these problems. The relationship between mechanisation and the economy of coal production remains a central issue throughout the chapter.

The effect that new technology had on the work and workers in Scottish pits is analysed in chapter 3. The impact that technological change had on skill levels, employment, work intensification and conflict over control in the workplace receives detailed scrutiny. The methodology is primarily a review of various primary and secondary source materials to test several theories and to discern whether modernisation of mining practices in Scotland were beneficial or detrimental to colliers. Although the bulk of the evidence is qualitative, a quantitative study is conducted to show how mechanisation was both advantageous and damaging to the employment opportunities of miners.

Health and safety of Scottish mineworkers is the focus of chapter 4. The discussion being whether the introduction of modern mining methods resulted in improved safety for Scottish colliers or a decline in safety standards. Once more statistical exercises are employed to test these assertions. The study compares the experience of Scottish miners at national, county and individual mine level to demonstrate the consequences continued diffusion of machine mining had on mine safety.

In chapter five the labour relations side of the equation is explored. Industrial unrest, in general and specifically in relation to the diffusion of machine technology, is investigated. Due to the enormity of this topic much of the research is centred on two in-depth studies on labour unrest in Lanarkshire during the 1910-1914 and 1932-1938 periods. Labour relations in other periods and other Scottish coalmining districts are also investigated, for example, the Fife and Ayrshire districts. The approach adopted is both qualitative and quantitative. Statistical evidence is produced and evaluated probing the linkages between mechanisation and high levels of industrial unrest in Scottish coal mining districts. The various threads of the arguments and findings of the research are drawn together in the final chapter.

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[1] At the outset it should prove helpful to outline some areas that this investigation will not deal with in any great depth. Firstly, it is not intended to provide a history of technology of the mining industry. Any reader interested in this area should consult A R Griffin, *Coalming*, (1971), for a brief but informative overview of the main changes in mining technology during this period. For a more in-depth study of this topic readers should consult some of the contemporary technical manuals, like G L Kerr's *Practical Coal Mining*,(1914), or *Practical Machine Mining*, (1928), by M D Williams. In a similar vein the thesis does not deal with the political history of Scottish mineworkersto any great extent. Page-Arnot's *History of the Scottish Miners*, (1955), provides an excellent starting point for readers with an interest in this subject. For a more up to date review Campbell's work on Scottish coalmining in the first half of the twentieth century should be consulted. Two articles in particular are of interest 'The CP in the Scots coalfields' in Andrews, Fishman and Morgan's *Opening the Books*, and 'The social history of political conflict in the Scots coalfields', in A Campbell, N Fishman and D Howell's *Miners, Unions and Politics, 1910-1947*, (1996).

[2]*Colliery Guardian*, Vol CXLVII, 3 November, 1933, p 823.

[3]See chapter 1 for a more extensive and comprehensive coverage of arguments on the possible advantages and disadvantages of the switch to machine mining practices in the Scottish coal industry.

[4]B Elbaum & W Lazonick, 'The Decline of the British Economy: An Institutional Perspective', *Journal of Economic History*, Vol 44, (1984).

[5]Ibid, pp 572-573.

[6]Inspector of Mines Report, Scottish Division, 1928, p 9.

[7]R Page-Arnot, *A History of the Scottish Miners, from the Earliest Times,* (1955).

[8]A Campbell, *The Lanarkshire Miners: A Social History of Their Trade Unions, 1775-1874*, (Edinburgh, 1979).

[9]A R Griffin, *Coalmining*, (1971). A R Griffin, *The British Coalmining Industry: Retrospect and Prospect*, (Stoke on Trent, 1977). Other works worth consulting include; N K Buxton, 'Entrepreneurial Efficiency in the British Coal Industry Between the Wars', *Economic History Review*, Vol XXIII, (No. 1), (1970), Buxton 'Entrepreneurial Efficiency in the British Coal Industry Between the Wars: Reconfirmed' *EHR*, Vol XXV, (No. 4), (1972), Buxton *The Economic Development of the British Coal Industrial Revolution to the Present day,* (1978), A J Taylor, 'Labour Productivity and Technical Innovation in the British Coal Industry, 1850-1914,' *EHR*, Vol XIV, (No. 1), (1961), pp 48-67. For an international comparison see A Beacham, 'Efficiency and Organisation of the British Coal Industry', *The Economic Journal*, Vol LV, (1945).

[10]Griffin, 1977, p 142.

[11]This theory on Scotland's early lead in mechanisation in the pits is disproved below, see chapter 1, pp 21-22.

[12]Griffin, 1971, p 120.

[13]M W Kirby, *The British Coalmining Industry 1870-1946*, (1977), p 193.
[14]R Church, *The History of the British Coal Industry, Vol 3, 1830-1913, Victorian Pre-eminence,* (Oxford,1986) and B Supple, *The History of the British Coal Industry, Vol 4, The Political Economy of Decline 1913-1946*, (Oxford, 1987).
[15]Church, *History*, p 346.
[16]Ibid, p 356.
[17]See chapter 1, pp 20-22.
[18]Supple, History, p 435.
[19]Ibid, p 438.
[20]A Slaven, *The Development of the West of Scotland, 1750-1960,* (1978), p 168.
[21]B Lenman, *An Economic History of Modern Scotland 1660-1976*, (1977), pp 181-182.
[22]A Marwick, *Scotland in Modern Times*, (1964).
[23]R H Campbell, *Scotland Since 1707 the Rise of an Industrial Society*, Second Edition, (Edinburgh, 1985), p 197.
[24]R H Campbell, *The Rise and Fall of Scottish Industry, 1707-1939*, (Edinburgh, 1980).
[25]J Whiteside, *Regulating Danger: The Struggle for Mine Safety in the Rocky Mountain Coal Industry*, (Nebraska, USA, 1990).
[26]A Barratt Brown, *The Machine and the Worker*, (1934), B L Coombes, *I Am a Miner*, (1939), M Heinemann, *Britain's Coal, A Study of the Mining Crisis,* (1944), J Jones, *The Coal Scuttle*, (1936).
[27]J Hyslop, *Colliery Management*, Second edition, (1876), C M Percy, *The Mechanical Equipment of Collieries,* (Manchester, 1905), M D Williams, *Practical Machine Mining*, (1928).
[28]G L Kerr, *Practical Coal Mining*, fifth edition, (1914).
[29]*Colliery Guardian*, each issue between 1890-1939 was systematically consulted and proved a rich source of material which was very helpful to this thesis. Any reader with an interest in the mechanisation of the coal mining industry would do well to refer to this publication, particularly the series of articles devoted to this subject in the 1900-1901 issues.
[30]The inspector for the eastern division was the only official in Britain to record the mines using coal cutting equipment in his region in the years before 1910.
[31]See chapter 4, tables 4.8 and 4.9, pp 185-186.

CHAPTER 1

Technology and Labour: Theory and Historiography with Special Reference to the Mining Industry.

> Scientists and engineers have played an essential part in the evolution of labour movements, which have been an integral feature of industrialisation. The "Machine Question," that is the recurring struggle over the control of technological change and its consequences, testifies to the very strong links between the history of technology, economic history and labour history. The exact nature of this interaction, between technology and social-economic change is a subject of debate.[1]

This chapter will investigate various theories on the relationship between the impact of new technology on industry and the effects modernisation had on work and workers in industry. Consideration will be given to the changes that technological improvements necessitate within industry. The main areas to be looked at include the effect new technology has on workers. Does it lead ultimately to a deskilled workforce, vastly reduced in numbers through unemployment, alienated and demoralised due to the intensification of work and being paced by machines? Does technological change also mean a loss of power and control for labour in the workplace? The second main area of study will concentrate on the impact technological change had on the health and safety of workers in industry. Did the switch to modern production methods prove beneficial to labour by improving working conditions and reducing the risk of injury and death in the workplace, or were hazards increased as a result of technological change? Finally, the reactions of labour to change within industry will receive detailed analysis. Was labour, due to the strength and organisation they commanded in the workplace, able to hold back or delay change, or was labour more forward looking and progressive in their attitude to technology? Can labour be viewed as a homogeneous body with a unified attitude to change, or did splits exist within and between labour with regards to the growing modernisation of industry? Furthermore, can the various eras of growing industrial unrest in the period be attributed to labour's fight to prevent change or did the technological metamorphosis itself bring with it new issues which led to increased conflict?

Each facet of this investigation will start by considering the various issues from the broader perspective of how new technology impacted on workers in general, drawing on examples from several industries. Then there follows a more detailed analysis, which centres on the experiences of workers in the Scottish mining industry between the years 1890-1939, testing these various and varied hypotheses in the context of the Scottish coal industry. Such an investigation should provide a detailed profile of the profound consequences that the impact of new technology had on one specific group of industrial workers.

There are two basic and contradictory views on the effects new technology has on workers and society. The 'optimistic model' portrays technological change as restructuring employment. That is, although some skills are displaced by new work methods and processes other skills are created which compensate for the loss of the original skills. The hugh increases in productivity that new technology give rise to will result in high levels of consumption. The spending power derived from these productivity gains will create demand for more services and products which will manifest itself in a new range of jobs. In addition to creating new employment opportunities, new technology would also benefit labour in the work place because it was seen as making work easier. Machinery, for example, could remove the drudgery and toil from manual labour and so ease the burden of workers. As well as reducing physical effort modernisation of work practices could, in some instances, improve the health and safety of labour. This school of thought depicts technological change as having an ameliorating influence on industrial labour.

The 'pessimistic model', on the other hand, posits technological change as leading to the deskilling of labour, intensification of work, unemployment and the loss of job control at the point of production. Marx argued that this displacement of labour is progressive:

> the labouring population...produces along with the accumulation of capital produced by it, the means by which itself is made relatively superfluous, is turned into a relative surplus population; and it does this to an always increasing extent.[2]

If this theory is correct and is carried to its logical conclusion then labour would eventually be replaced by automated production processes. This scenario assumes, of course, that labour is acquiescent or powerless to oppose this appropriation of its function in the workplace.

Many commentators of the pessimistic school acknowledge that technological change leads to the downgrading in status of skilled workers and also to redundancies. I Benson and J Lloyd in their study on the relationship between new technology and industrial change state, 'the introduction of new technology is primarily seen by employers as a labour-saving device'.[3] These authors also provide empirical evidence which shows the deskilling effect of new technology.

Looking at the engineering sector they show that between 1914 and 1933 the division between skilled, semi-skilled and unskilled workers was changed to such an extent that craft workers seemed to have been replaced by 'machine-minders'.[4] It should be noted, however, that the changed ratios between these categories of workers does not necessarily mean that craftsmen were directly down-graded to machine-minders or that manual labourers were up-graded. It is possible that different workers came into the industry during these years.

Braverman argues that capitalism seeks to control the variability of human labour by separating the tasks of conception and execution, or mental labour and manual labour. In adopting this strategy management is able to gain control at the point of production. Braverman views the introduction of machinery as having two functions. Firstly, it increases the productivity of labour. Secondly, and perhaps more importantly, he sees machinery as pacing workers, 'machinery...has in the capitalist system the function of divesting the mass of workers of their control over their own labour'.[5]

A Friedman makes a similar observation in his book *Industry and Labor*:

> Under the old system managers had to rely on workers' handicraft skills for guidance as to the best methods for carrying out particular tasks. Now machines are used as the basis around which work tasks are organised. Machines pace workers and define their particular tasks.[6]

Friedman also points out that new technology can result in specialisation of tasks within industry. The splitting up of tasks into component parts has the effect of reducing the value of labour. Training, for example, is quicker and therefore cheaper, thus allowing capital to employ different, lower paid labour.[7] Furthermore, the division of skill reduces the autonomy and control workers have over production leading to the alienation of labour.[8] Thus, not only is the burden on workers increased, skill levels and control at the point of production are reduced and jobs lost.

J Gennard and S Dunn's findings in their work on the printing industry confirms the view that technological change, in this sector at least, led to a decline in skilled personnel.[9] However, they also acknowledge the new skills that technology created. The introduction of new technology in the printing industry has led to an increase in importance of technologists, technicians, estimation, computer operators and other non-manual occupations. Yet it is not clear whether this increase in importance has led to an increase in skill levels.

The concept of skill is difficult to define and quantify. The length of training period is, perhaps, one way of measuring skill. Gennard and Dunn posit that the majority of white-collar jobs in printing, on average, required a training period of two and one half years. Skilled print workers served a six year apprenticeship. Thus, although it could be argued that new technology did lead to a re-structuring of occupations these required lower skill levels and, hence, technological change, in this industry, resulted in the deskilling of labour. However, this assumes that printing apprenticeships needed to be six years duration. It could be argued that much of this time was spent on repetitive tasks - thus the apprentice was just a form of cheap labour.[10] Some of the new jobs, such as technologists and technicians, may require higher skill levels. However, Gennard and Dunn give no indication of the number of these higher skilled positions in relation to the numbers of craft jobs which were lost.

Some champions of the optimistic school, A Reid for example, suggest that new technology did not result in a deskilled workforce which lost control at the point of production. In his study of shipyard workers[11] Reid argues that this section of craft workers, partly because of their strong occupational trade unions, were able to maintain and, in some instances, increase their control of the work process. Citing the example of pneumatic riveting this author contends that labour was able to accept this new work method on their own terms. That is, staffing levels and wage rates which had applied to hand-riveting remained in force after the semi-automatic process was introduced.[12]

E H Lorenz, in his study of British shipbuilding argues that much of the new technology which was introduced in ship construction in this period was not semi-automatic and, thus it was not intended for use by operators of lower skill. Indeed, this technology was designed to increase the productivity of skilled workers.[13] Modernisation of shipbuilding practices through improved technology in this instance would have led to an increase in job control. Reid and Lorenz, therefore, seem to be in agreement on this point. Nevertheless, it should be noted that, shipbuilding employers held the opinion that the main characteristic of their industry was that it was predominantly a highly skilled labour intensive operation. This was one of the main factors which sustained Britain's lead in this sector in the period before 1914. Shipbuilding employers, indeed, were of this opinion until the relatively recent past. Management in British yards remained heavily dependent on their skilled workers for shop-floor control and organisation - even in 1975 British builders employed fewer designers, technicians and supervisors than their main rivals.[14] This stresses the great autonomy in job control held by shipyard labour. Moreover, it could be argued that a major factor which prevented the deskilling of shipyard trades was that employers had no wish to reduce skill levels - on the contrary they actively supported an increase in skill levels. It would, therefore, be interesting to see how Reid's theory that new technology led to an increase in skills and control would stand when applied to an industry, mining, for instance, where management were determined to gain greater control in the workplace through the introduction of innovative technological and organisational change.

B Supple's comprehensive study of the British coal industry between 1913-1946 provides a further insight on the effect mechanisation had on the industry and its workers. Supple notes the many negative effects mechanisation had on mineworkers:

> The introduction of machine mining in the twenties and thirties - and particularly the introduction of cutters and conveyors on longwall faces - diminished the need for the traditional skills of the hewer (primarily because undercutting was now done mechanically); substantially extended the size of mining teams; reduced the autonomy with which the senior face workers and their immediate colleagues could operate; and further increased the need for supervision and the interdependence of work tasks not merely within the larger groups but also between different groups and different shifts....Clearly, in addition to the disruption of conventional skills and the derogation of the hewer's traditional status, the new mining systems involved the loss of individual determination of work tasks, much closer supervision, and the heightened pressure which came from interdependence of the system as a whole.[15]

Supple does note that mechanisation could have meant a change in skills rather than a reduction of them. He goes on to describe the way intensive machine mining changed the nature of work in coalmines:

> that strength rather than dexterity or experience was becoming 'paramount'. At the face in particular the 'complete collier' of the past was being replaced by 'mechanics and the like semi-specialised craftsmen' and 'a substantial proportion' of workmen who were 'primarily manual labourers'.[16]

Even though Supple appears to concede the optimists may well be correct in arguing that new technology can result in changed skills not deskilling, his description of the new range of workers in the mines favours more the pessimists' viewpoint. For instance, that strength was becoming more important than experience or dexterity reinforces the belief that work in the pits was becoming more onerous. Furthermore, his description of mechanics, semi-specialised craftsmen and manual labourers emphasises the division of labour and deskilling tendencies that accompanied new technology.

A Campbell argues that similar situation existed in Scottish pits. In his study of mechanisation in the Lanarkshire mines he notes, 'perhaps the most obvious effect of mechanisation was the deskilling of the hewer'. Mechanisation also led to a 'replacement of skill by physical strength', indeed, the miner was *now* 'reduced to the status of a living tool'.[17] A contemporary account, written in the early thirties by W Gallacher, supports the view that new technology had deleterious consequences for labour. Gallacher's description illustrates how mechanisation resulted in increased supervision and work intensification. The system worked as follows. Coal which was extracted by mechanical cutters working nightshift had to be cleared by the dayshift squads. This often entailed dayshift workers being forced to work over the eight hour shift so that all was ready for the machine cutters that night.[18] Alternatively, work on the nightshift could be held up due to mechanical or electrical breakdown of coal cutting machines. This resulted in workers on the cutting shift having to work on to finish their cut, usually the full length of the coal face. Trade union records from the period validate Gallacher's claim. The Lanarkshire Miners' County Union provide many examples. The situation at Russell's Greenfield mine in 1913 being typical. The records show that miners at this pit were working between 12 and 16 hours per day.[19] The position had changed little some twenty years later when, according to Andrew Clarke, president of the National Union of Scottish Mine Workers, miners in the Scottish coalfields were working eight and nine shifts per week.[20] The problem of excessive overtime had become so acute that in 1935 a special enquiry, conducted by the Mines Department, was held to determine the reason behind the abnormally high incidence of overtime in Scottish mines. The findings of this enquiry noted that the level of overtime worked in Scottish pits was eight times the national average. The report highlighted that overtime was almost always confined to collieries where machine mining was practised:

> Much overtime is said to be due to one class of worker waiting for another to get clear. Coal cutting machinemen delay the other workers when their machines break down, as they are unable to complete their work, and this is this cause of much overtime by strippers, brushers, packers and panmen. If any of these are held up the cycle of operations is broken which may involve overtime by haulage workers as well.[21]

Consequently, the prevailing view from the historiography is that technological change, when applied to the mining industry, resulted in deskilling of mineworkers, increased physical effort and intensified work in the pits owing to the tendency for machines to dictate the pace of work. This will be tested more fully in the pages that follow.

Another feature of the application of new technology to industry which could have a serious effect on workers was the threat of unemployment posed by modern production systems. As noted by Benson and Lloyd above, new technology was invariably seen by employers as a labour saving device.[22] A Muir, in his history of the Fife Coal Company, highlights this point and in so doing reinforces the arguments of the optimists. He stresses that new technology makes work less wearisome for colliers:

> In planning the colliery (Comrie) Mr Reid's policy was to cut down to a minimum the use of unskilled labour. The method of filling the skips under the control of one intelligent operator was devised to eliminate the laborious work of many men, and the same manpower economy can be seen throughout the entire colliery.[23]

It could be argued that technological change at this Scottish mine did result in the acquisition of new skills. That is, haulage operations were now controlled by one intelligent, and undoubtedly skilled man, but at the expense of how many others? Implicit in this statement is the fact that new technology at the Comrie mine meant unemployment for mineworkers. P B Long in his thesis on the Scottish Coal Industry provides further evidence of the labour shedding nature of mechanisation, 'the sharp rise in the use of conveyors, adopted primarily as a means of shedding labour, was general throughout Scotland between 1925 and 1927'.[24]

Thus it seems the pessimists are correct, mechanisation did pose a threat to the employment prospects of workers in Scottish pits. Page-Arnot's history of the Scottish miners provides the following employment statistics. During the twenties and thirties Scottish mining contracted in labour power more rapidly than British mining as a whole. Numbers employed fell by over a third, from 143,267 in 1923 to 82,358 in 1932. Whereas the English and Welsh sectors had only been reduced by one quarter.[25] Acknowledging that Scottish mining was more mechanised than its southern neighbours the question must be asked whether this sharper decline in numbers employed was influenced by the more progressive mechanisation programme of the Scottish coal owners? Indeed, was the faster rate of decline in Scottish mineworkers partly due to technological unemployment as suggested by Lythe and Butt?[26] If unemployment was a corollary of mechanisation then it is not surprising that mineworkers, as Zweig acknowledges in his study on the coal industry, regarded machines as 'silent blackleg workers'.[27]

When new technology is introduced into industry it is usually necessary to adapt existing work systems or completely redesign them. In mining it was normally the case that machine cutting and conveying was adopted by firms engaged in the longwall system of mining. A R Griffin states, 'the more progressive companies working longwall had gone over almost entirely to cutting and conveying coal by machine by the start of World War II'.[28] If this was true of Scottish mining as a whole, and considering the lead shown by Scottish coal owners in the introduction of mechanised extraction, then the decades before World War II must have witnessed a major increase in mechanisation. This suggests, consequently, that miners in Scottish pits would have been confronted with a sustained attack on their control at the point of production. If these workers were subjected to such an attack coupled with the burden of increased hours of work and an increase in the tempo of work due to the pacing effect of machinery then the Scottish industry during this era would seem to offer all the right ingredients for a study on the impact of new technology on work and the workers.

Mechanisation and Health and Safety in Scottish Mines.

The impact of mechanisation on the safety of mineworkers is one area which has received little attention in the general historiography of technology and, more particularly, mining. As little research has been conducted on this topic a comprehensive search of contemporary material was undertaken to establish the advantages and disadvantages which were thought to have accompanied the move to modern mining techniques. An extensive and intensive trawl of the *Colliery Guardian* has produced an abundance of data. Reports and transcripts of numerous technical studies indicate that many proponents of machine mining techniques considered modern mining systems would prove a boon to mine safety. Thus, once more a case can be made which fits the optimists' model - that the introduction of new technology into Scottish pits enhanced the safety of miners.

Very early in the period of this study one commentator argued that the speed of machine cutting would reduce the risk of roof falls, the principal cause of accidents below ground. He contended that mineworkers were at greater risk when cutting by hand because the slow rate of advance meant they worked under suspect roofs for long periods. Using new cutting methods this time of greatest danger was markedly reduced, thus the risk of falls and injury was also diminished.[29] Furthermore, the undercutting of coal by machine meant miners no longer had to lie beneath the coal as was the case with hand cutting. Thus machines made this dangerous operation obsolete and consequently, reduced the chance of injury. The introduction of machinery into the industry supposedly improved the lot of the collier because it made his job easier. Mechanisation reduced the drudgery of pitwork and relieved the burden on miners. This, L J

Barraclough argued, would give the miner more time to devote to his personal safety.[30]

Furthermore, official figures indicate that mine safety improved during this period of modernisation within the industry. For instance, the death rate per 1,000 miners in British mines fell by half between 1873 and 1938, from 2.24 to 1.10.[31] What factors can account for this improvement? N K Buxton and R A Church argue that a major factor in reducing accidents from explosion were improved ventilation systems and safety lamps.[32] Increased supervision and co-ordination of operations at the coal face, which were a prerequisite of machine mining, should also have proved beneficial to safety. G L Kerr noted, 'regular and more systematic working tends to increase the safety of the workmen'.[33] For example, mine officials would have had greater control over propping operations thus the chance of roof falls should have been reduced. These few examples give a taste of the way many commentators thought of new technology as having a positive effect on mine safety.

On the other hand, there are many counter-arguments, which show the growing move to machine mining in a negative light in relation to mine safety. For example, the increased speed at which the coal face advanced when machine mining was used may have created greater hazards for miners in Scottish mines. A significant number of pits in Scotland were classed as non-gassy, that is the risk of explosion of fire-damp (methane) was considered to be negligible and many workers in these pits used naked lights. Coal is partially decomposed organic material and methane gas is a bi-product of that decomposition. When a coal seam is worked and the weight of the roof comes on the coal the gas is released into the atmosphere.[34] The concentration of fire-damp in many Scottish coal seams was low enough to be considered safe. This, however, was when the coal was being worked by traditional hand methods. The greater rate of working using coal cutters increased the area of coal being extracted and increased the volume of gas emitted from the mineral. Consequently, the risk of explosion was also increased.[35]

The switch to mechanised production may have increased the incidence of falls because a greater expanse of roof was left unsupported when undercutting by machine. The introduction of face conveyors further exacerbated this problem.[36] Thus, a significant area of roof would be unsupported and the danger of roof falls increased. The machines themselves and the power sources used to drive them also brought an added risk of injury to colliers. The growing use of electrically driven machinery in the pits brought the risk of electrocution. Thus, the very machinery of the new working systems posed a new and significant threat to mineworkers.

Mechanised production meant increased noise, vibration and dust levels in the pits and these added to the risks faced by colliers. Miners working the coal using traditional hand-hewing techniques were able to gauge the condition of the roofs by listening to the noises they made. When the creaking of the roof got to a certain stage mineworkers knew that a fall was imminent and they were able either to fit more props or affect their escape. Mining machinery created such noise and vibration that workers could no longer hear roof movements and thus were unaware of potential falls.[37] Vibration, particularly from conveyors, could also weaken suspect roofs and cause them to collapse. Dust created by machine cutters and conveyors increased the chance of underground explosion as coal dust when mixed with methane proved a lethal combination as the following statement indicates:

> local explosions of fire-damp usually did little harm to men and equipment; however, when exploding methane mixed with coal dust, the result too often was disaster. Once ignited, an explosion of coal dust seemed to set the very air on fire. Survivors of gas and dust explosions sometimes described a tongue of flame racing through the mine. On the surface the report of an explosion might sound like a gigantic cannon or be felt, more than heard, as a muffled shudder. As often as not, more men died of suffocation than from the actual flame and concussion of an explosion. As a blast moved through a mine it consumed all the oxygen and left behind a deadly mixture of carbon monoxide (white-damp) and carbon dioxide (black-damp), known to miners as after-damp. Men caught in the after-damp lost consciousness in a few seconds and usually died in a few minutes. Rescuers would find them sitting with tools, or even food and drink, in their hands; kneeling as if in prayer; or lying down as though they had just gone to sleep.[38]

Also, as has been outlined above, the introduction of mechanised extraction methods resulted in miners being paced by the machines. This intensification of work in the pits led to a rise in accident rates as the workers strove to keep pace with the machinery.[39] Once more it can be argued that new technology in the form of coal cutting machines and mechanical conveyors had a detrimental effect on mine safety.

The Impact of Mechanisation on Labour Relations.

If it is accepted that the mechanisation of the Scottish coal industry had such a profound effect on the work and workers in the industry then it would not be surprising in the least to expect these changes to have also had a significant impact on labour relations within the industry. The relationship between the diffusion of new technology and the reaction of labour to it is the subject of much debate. Some historians, B Elbaum and W Lazonick for example, assert that one factor affecting Britain's inability to match her competitors' economic success was the presence of strong labour organisations. These authors argue that much of the success of the American, German and Japanese economies was due to the fact that corporate capitalism in these countries had managerial control over the labour process. This control facilitated the introduction of new technologies and new modes of work organisation such as scientific management. British capitalists, however, were unable, despite the introduction of many skill-displacing changes offered by new technology to replace the job control of the shop-floor union organisations.

Paramount to the success of these economies, in Elbaum and Lazonick's view was, 'the ability of management to gain and maintain the right to manage the utilization of technology'.[40] In Britain's staple industries much of this right to manage had been lost. W A Lewchuk argues in a similar vein. He states that British businessmen were forced to reject scientific management and Fordism because they were unable to achieve the degree of managerial control that these systems required.[41] Elbaum and Lazonick suggest that in the first half of the twentieth century, 'British unionism was able to consolidate its position of control at both national and workplace levels, aided by the strength of the Labour Party and the emergency conditions of the two world wars.'[42]

Elbaum, Lazonick and Lewchuk view the rigid work rules of British unions as an impediment to structural organisation by limiting management's freedom to alter staffing levels or workloads. How true then is the theory that the strength of organised labour and the lack of managerial control at the point of production prevented British industry from competing favourably with her rivals? Did the strength of labour opposition deter British entrepreneurs from adopting new technology? The previous evidence from the shipbuilding industry (Reid and Lorenz) and the research carried out by J McGoldrick suggest that labour power did influence the way new technology was introduced into the shipyards.[43] The earlier example of pneumatic riveting suggests that the strength of labour was instrumental in ensuring this process was brought in on the workers own terms.

Yet these new methods were introduced - labour opposition did not prevent management from implementing technological change. Also, considering the question of control at the point of production it should be re-emphasised that labour's widespread autonomy in shipbuilding was sustained as much by management's approval as by strong labour organisation.

Contemporary comment from officials in the coal industry also appear to support this view that labour opposition was a significant factor in retarding the modernisation of the industry. For example, Sir Charles Carlow Reid, chairman of the Technical Advisory Committee of the Ministry of Fuel and Power in 1944, inferred in the ensuing report that pit labour was obscurant with regard to new technology. One reason for the lack of investment in new technology and restructuring in the coal industries was, 'the lack of cooperation between owners and miners as indicated by the reluctance of the latter to accept mechanisation as a necessity'.[44] Implicit in Reid's statement is the assumption that labour was obstructive to the implementation of modern working methods in the pits.

Prior to his appointment to the Ministry of Fuel and Power Reid had been the general manager and a director of the Fife Coal Company Ltd., - a company, as will be shown in the following chapters, which was one of the leaders in Britain in adopting modern mining practices. It must be wondered how much Reid's experience with this undertaking influenced the conclusions of the committee? In 1938, for example, 86 percent of mines in the Fife district used coal cutters, 90 percent of coal was cut by machinery and 84 percent of this tonnage was mechanically conveyed.[45] Bearing these facts in mind, it seems unlikely, at first glance, that labour in the Fife region was as obscurantist as Reid suggests. Was this criticism of the industry, therefore, being levelled at other, less progressive, districts in Britain? And considering the extent of mechanisation in

Scottish mines, does this imply that owners and labour north of the border were more enlightened in their attitudes to technological change?

Elbaum and Lazonick's theory that strong labour organisation in British industry was a significant factor which delayed or curtailed the introduction of new technology is based, primarily, on their work in the textile industry. If the theory was applied to the Scottish mining industry during the years 1890-1939 would similar conclusions be reached? A cursory glance at data detailing the diffusion of machine coal cutters and conveyors and coal output in this period suggests this was not the case. In 1904, for example 12 percent of Scottish mines were engaged in machine mining. These mines produced 4.8 percent of total Scottish coal output. In 1938, 56 percent of mines were mechanised and accounted for 80 percent of output.[46] These statistics indicate the improbability of the application of new technology to mining operations in Scotland having been prevented or delayed by labour opposition.

It could be argued that in the inter-war period especially Scottish mining labour was both numerically and politically weak. Indeed, the power of organised labour was further reduced by the federated nature of its organisation. That is, there were several county unions which fought amongst themselves, thus limiting the effectiveness of opposition. Thus it could be that mining labour, given these facts and taking cognizance of the pressures imposed on mineworkers by the prevailing economic climate, was in no position to offer any resistance to the modernisation plans of coal owners. In this case it might be thought somewhat unfair, perhaps to apply Elbaum and Lazonick's theory to the Scottish coal industry. However, it should be noted that labour in all Britain's staples industries, including textiles, was in a similar position in the inter-war years, thus if labour in textiles was able to delay or prevent the introduction of technology change then mining labour may also have had the same power.

Mining labour in Scotland's mines, however, was in a much stronger position in the earlier years of this study. This being particularly true in the quinquennium before the First World War and in the years that immediately followed. These were indeed turbulent years in the industry. Labour relations were tempestuous and strike levels extremely high as miners exerted their power in an attempt to improve wages and working conditions. Yet these years did not see a reversal or slowing down in the modernisation of the industry. The diffusion of new cutting technology and reorganisation of work practices continued unabated. This suggests that the situation in the Scottish mining industry does not support the conclusions reached by Elbaum and Lazonick for the British textile industry.

Benson and Lloyd propound that technological change is introduced at times of recession and rising unemployment. Although they were dealing with the situation in the 1980s, the industrial and economic scenario of the twenties and thirties fits these parameters well.[47] When the aggregate figures for Scotland are considered, especially those for tonnage cut by machine (from 32 percent in 1921 to 80 percent in 1938) they appear to support Benson and Lloyd. It would seem that Scottish coal owners did taken advantage of their increased power in labour relations to advance modernisation of the industry. When the data on the number of mines engaged in mechanical cutting is analysed it is found that they increased from 48 percent to 56 percent over the same period.[48] This suggests, however, that by far the biggest strides forward in modernisation were occurring at mines which were already engaged in machine mining. That is, an expansion and intensification of mechanisation was occurring at mines that had already experienced technological change. It would be reasonable to argue that coal owners could expect less opposition from miners who were accustomed to mechanised mining methods than from those to whom these new work processes were unknown. Thus, perhaps it was not just the economic dislocation of the period that accounts for the apparent painless introduction of machine cutting and conveying to Scottish mines.

One reason for the apparent lack of labour opposition to technological change has been unearthed by Benson and Lloyd's research. While researching the post-1945 situation these authors noted that trade union concern over the impact of new technology has been slow to develop. This was partly due, they contend, 'to the piecemeal way in which discrete functions were automated made it difficult for unions to detect any overall pattern to the changes that were taking place at that time.'[49]

There is little reason to assume that the situation prior to World War II should have been any different. Indeed, Campbell argued that a similar situation occurred in Lanarkshire mines in the earlier years of the century,[50] Campbell also notes that no evidence can be found of direct opposition to mechanisation by mining unions. However, he does argue that the vast majority of disputes between mineworkers and coal companies over mechanisation were concerned with tonnage rates and new working conditions, not with the introduction of the machinery itself.[51]

Moreover, the Lanarkshire Miners' County Union accepted mechanisation, despite the fact that twenty machine cutters could do the work of fifty hand hewers, because it was seen as being the only competitive way to exploit the coalfield's remaining seams.[52] That is, because of geological conditions (steeply graded, thin seams which resulted in prohibitive face labour costs) many pits in this area would have been abandoned as uneconomic if machine mining and mechanical conveying had not been introduced.[53] If this was the case it is perhaps not surprising that colliers in this region offered little resistance to the introduction of modern mining methods.

This point, made by A Campbell and also by McKechnie and McGregor in their work on the Scottish coal mining industry requires further investigation. If it was true that the Lanarkshire coalfield could only be worked productively using machine mining techniques then one would expect to find this sector of the Scottish coal industry to be at the forefront of machine mining technology. Statistics show, however, that it was the developing coalfields in the east of Scotland which were the pace setters in adopting new cutting and conveying technology. In 1914, for example 70 percent of Fifeshire mines were recorded as using coal cutters whereas the corresponding figure for Lanarkshire was slightly less than 42 percent.[54] Indeed, during the later period of this investigation Lanarkshire is the only district which witnessed a decline in pits using machine cutters. The percentage of mines employing cutting machinery dropped from 51 percent in 1921 to 46 percent in 1938.[55] This data suggests that the switch to machine cutting should not be seen as the last chance for coal mining in this region and, by the same token, neither can it explain the apparent lack of resistance by mineworkers to technological change in the Scottish pits.

This also brings into question one of the more common explanations for Scotland's earlier lead in the modernisation of its mining industry - that diminishing returns forced coal owners to adopt mechanisation. Supple makes this point in his study of the British coal industry:

> Thickness of seams...perhaps the most important consideration, since there were considerable relative economic advantages in mechanised cutting in thin seams. Hence, there was a noticeable inverse correlation between the thickness of seams and extent of mechanisation, and the thinness of Scottish seams, together with the greater difficulty of working them, were offered as reasons for Scotland's exceptional high use of cutting machinery.[56]

Other commentators N K Buxton, for instance also attribute Scotland's lead in mechanisation to this factor. 'The greater technical efficiency of the Scottish district can be regarded as an attempt to offset diminishing returns'.[57] However, as it has been shown above, it was the coalfields in the east of Scotland, Fifeshire, Clackmannan and Mid and East Lothian, which took the lead in the mechanisation of coal production. These coal fields were also the fastest growing coalfields at the end of the nineteenth century and the early twentieth century.[58] It seems unlikely that coalfields which were developing new mines (the emphasis being on developing) at such a rate and were employing modern mining technology would be subjected to diminishing returns.

TABLE 1.1 AVAILABLE COAL SUPPLIES SCOTTISH MINES, 1905.

Coalfield	Calculated Supplies (Million tons)	% over 24 inches
Fife & Kinross	3742.3	81
Mid & East Lothian	2520.3	82
West Lothian	574.8	59
Lanarkshire	2604.5	45
Ayrshire	1089.6	80
Clackmannan	443.8	72
Stirlingshire	1316.7	52

Source: *Final Report of the Royal Commission on Coal Supplies*, (B P P) 1905, (Cd.2359). Part VIII, Report of J S Dixon on Available Coal Resources of District F, Scotland.

As regards the thinness of coal seams in Scotland the Royal Commission on Coal Supplies, 1905, determined that the available coal resources were as shown in table 1.1 This data supports the view that greater reserves of coal in thicker seams were located in the east of Scotland. D Greasley has shown that in 1939, 74 percent of Scottish coal output was produced from seams measuring 30 inches and above.[59] Individual coalfields had the following percentage of coal extracted from seams measuring 30 inches plus; East Fife 90 percent, Central Fife 90 percent, West Fife 70 percent, Mid and East Lothian

85 percent, Ayrshire and Dumfermline 89 percent, and Central and Douglas Valley (Lanarkshire) 55 percent.[60] Coal seams measuring 30 inches thick were not generally considered as being thin by Scottish standards.

If Scottish mine owners were subjected to falling profits due to the law of diminishing returns *viz a viz* the need to work thin seams then one would expect the proportion of total output coming from seams measuring 24 inches or less to have increased throughout the period. In fact the reverse is true. The proportion of such coal constituted 16.1 percent of total output in 1900. In 1938 this percentage had fallen to 11.6. Conversely, production from seams measuring 72 inches plus increased from 9.7 percent to 12.3 percent. Coal extracted from seams measuring 42 to 54 inches thick remained constant throughout the era.[61] Thus, the argument that Scotland's lead in mechanisation was due to the diminishing returns resulting from thin seams requires to be re-thought.

Returning to the apparent ease with which Scottish mining labour accepted the introduction of new technology it has to be made clear that the views of labour in the workplace, the rank and file members, may have differed from those at trade union executive level. There were numerous strikes in the 1890-1939 period which occurred as a result of the changes to work arrangements and filling rates which can be linked to mechanisation. R Duncan's short study on the Shotts miners provides evidence that the miners struck because of the speed-up caused by mechanisation.[62] This suggests a difference of attitudes to new technology may have existed within the ranks of mine labour. The fact that disputes arose over tonnage/filling rates and changes to work practices in Scottish mines ought not to be automatically seen as the negotiated acceptance of mechanisation by all workers in the industry. Indeed, industrial unrest over such issues may be looked upon as one of the few ways mineworkers could protest against and contest the diffusion of machine mining throughout the Scottish coalfields. Perhaps the spread of mechanical cutters and conveyors and the impact they had on miners and their work was a factor behind the level of unrest in Scottish pits.

The proposition that technological change in the mining industry led to a deterioration of industrial relations is reinforced by J H Goldthorpe in his study of supervisor - worker conflict. He argues that the introduction of machine mining in the inter-war years altered the traditional relationship between the miners and mine - deputies. New work practises not only led to the 'demise of the almighty collier' - the multi-skilled craftsman through the deskilling of labour but also to an increase in the number of under officials whose role in co-ordinating underground operations became paramount to the success of the new system.[63] The stricter discipline and closer supervision that the new methods brought to mining led to an increase in conflict between miners and deputies. Goldthorpe argues that, 'a major cause of unofficial stoppages was the miner's resentment at what he considered to be arbitrary commands - such resentment is often at the root of strikes called for other overt reasons.'[64]

J Zeitlin's work on rank and filism predicates the theory that the closer links which developed between union leadership and capital since the last century did not necessarily end in the subjection of workers to unchallenged managerial authority as K Burgess and R Price have argued.[65] Zeitlin recognises that:

> in order to survive for any length of time trade unions bargain with employers over the wages and conditions of their members; and to sustain this role, they must become acceptable at least in some measure to their bargaining partners....the concern of trade union leaders for upholding collective agreements, particularly where these incorporate formal procedures for avoiding disputes such as conciliation and arbitration, ultimately leads them to adopt an active role in sustaining managerial discipline in the factory.[66]

This supports the idea that a possible disparity existed between the rank and file and trade union officials in the mining industry. Evidence exists which shows that such a rift existed in the Lanarkshire Miners' County Union in the period before the Great War. An example of pre-emptive action by rank and file workers is demonstrated by the strike at the United Collieries Nackerty mine in 1911. The dispute lasted for four months and involved 600 miners. Rank and file mineworkers did not start the strike but it was prolonged through the actions of mining activists who fought against the county union's call to return to work pending negotiations.[67] The conflict between rank and file workers and the union executive illustrates the growing dissatisfaction of miners with the increasingly institutionalised structure of collective bargaining being pursued by union executives. The action of the union officials, it should be noted, supports Reid's argument that union leadership was forced to maintain managerial discipline in the workplace. The system of collective bargaining being pursued by the union leadership in this period as Hinton noted, strained the relationship between trade unions and the more militant workers in the industry.[68]

Further evidence of schisms within Scottish mining unions can be found during the inter-war years. One of the main reasons behind the split in the Scottish mining unions in the inter-war period was the dissatisfaction of some younger, more militant miners over the conservative attitudes and actions of the leadership of the National Union of Scottish Mine Workers. This led to the formation of the break-away United Mineworkers of Scotland. Symptomatic of this conservatism, in the eyes of the United Mineworkers of Scotland, was the support of Mondism by the executive of the Miners' Federation of Great Britain.[69]

Having demonstrated that rifts existed between those at union executive level and some sections of their membership the question has to be asked whether the union leadership's acceptance of mechanisation of coal production techniques truly reflected the position of the bulk of their membership? Did some sections of mining labour oppose and contest the growing move to mechanised production or was acceptance of modernisation uniform throughout the pits? Indeed, the evidence suggests that mineworkers in Scotland were not obscurant but, in fact, that they had progressive attitudes to new technology. As the following statement, made in 1930 by J Masterton, Divisional Inspector of Mines in Scotland suggests:

> I have in former reports said that we find the men respond to the introduction of electricity and the changes that it brings with it. Their adaptability and the manner in which they help to make new machines a success would be amazing if one did not know them so well.[70]

Conclusion.

Considering the foregoing synopsis an investigation of the Scottish coal mining industry during the period 1890-1939 with regard to the effects of mechanisation of production processes on the work and workers in the industry, the implications that machine mining practices had on the health and safety of mineworkers and the impact such a move had for labour relations in the Scottish coal fields appears to be justified. There is much conflicting evidence as to whether new technology improved conditions in the pits. Did technological change lead to an increase in skills, improved job opportunities, greater control in the workplace for miners as Reid and Lorenz have argued for workers in shipbuilding or was the opposite the case? Are commentators such as Benson, Lloyd, Friedman and Goldthorpe nearer the mark with their views on the deskilling nature of mechanisation and their arguments that new technology resulted in fewer job opportunities, loss of control and increased conflict for industrial workers? As to the health and safety of workers in the industry was this improved by the switch to modern mining methods, as several contemporary commentators suggest, or was mine safety adversely affected as Whiteside argues was the case in western American mines? With regard to labour relations was labour in the pits responsible for holding back change as Elbaum and Lazonick contend was the case in much of British industry? Furthermore, did Scottish mine labour present a united front against the diffusion of new technology or was it equally unanimous in its support for change? Did a difference in attitudes exist within mine labours' ranks? Indeed, was mechanisation of extraction methods itself a factor which impinged on industrial relations? That is, did new production systems and organisation of work alienate Scottish miners and ensure continued and increased levels of conflict in the Scottish coalfields? The following chapters will be devoted to answering these points and hopefully the conclusions reached by this study of the Scottish mining industry will go some way to redressing the imbalance in the present historiography on the relationship between technological change and work and workers.

Notes for Chapter 1.

[1]I Benson & J Lloyd, *New Technology and Industrial Change: the Impact of the Scientific-Technical Revolution on Labour and Industry*, (1985), p 49.
[2]T Cutler, 'The Romance of Labour,' *Economy and Society*, Vol 7, No. 1, (Feb 1978), p 87.
[3]Benson & Lloyd, *New Technology*, p 182.
[4]See Chapter 3, p 127.
[5]H Braverman, *Labor and Monopoly Capitalism: The Degradation of Work in the 20th Century*, (New York, 1974), pp 193-195.
[6]A Friedman, *Industry and Labour: Class Struggle at Work and Monopoly Capitalism*, (1977), p 46.
[7]Ibid, p 18.
[8]Ibid, p 47.
[9]J Gennard & S Dunn, The Impact of New Technology on the Structure and Organisation of Craft Unions in the Printing Industry, *British Journal of Industrial Relations*, (March 1983).
[10]C More, *Skill and the English Working Class, 1870-1914*, (1980). More provides a detailed study on how skill was acquired and highlights the fact that many apprenticeships could have been completed in a shorter period. For a description on how skill was gained in coal mining see chapter 3, pp 122,123.
[11]A Reid, 'Employer's Strategies and Craft Production: The British Shipbuilding Industry, 1890-1950,' in S Tolliday & J Zeitlin(eds), *The Power to Manage*, (1991).
[12]Ibid, p 37.
[13]E H Lorenz, *Economic Decline in Britain: The Shipbuilding Industry, 1980-1970*, (1991), pp 45 & 46.
[14]Ibid, p 93.
[15]B Supple. *The History of the British Coal Industry, Vol 4, 1913-1946*, (Oxford 1987), p 435.
[16]Ibid, p 438.
[17]A Campbell, 'Colliery Mechanisation and the Lanarkshire Mines,' *Society for the Study of Labour History (Bulletin)* [henceforth] *(SSLH)* 49, (Aug 1984), p 39.
[18]W Gallacher, 'Coal Cutting Machinery in Lanarkshire Mines,' *(SSLH)* 49, (Aug 1984), p 44.
[19]National Library of Scotland (NLS), Lanarkshire Miners' County Union, [LMCU], Executive Minutes, 16/08/1913, DEP 227.55.
[20]NLS, National Union of Scottish Mine Workers, Reports on Annual Conference and Minutes of the Executive Committee, 1933, Presidential address by A Clarke, PDL/45/7, p 18.
[21]*Ministry of Labour Gazette*, September, 1935, p 332.
[22]Benson & Lloyd, *New Technology*, p 182.
[23]A Muir, *The Fife Coal Company Limited: A Short History*, (Cambridge, c.1954), p 93.
[24]P B Long, The Economic and Social History of the Scottish Coal Industry 1925-1927 with Particular Reference to Industrial Relations, University of Strathclyde PhD. thesis, 1978, p 130.
[25]R Page-Arnot, *A History of the Scottish Miners*, (1955), p 203.

[26]S G E Lythe & J Butt, *An Economic History of Scotland, 1100-1939*, (Glasgow, 1975), p 221.
[27]F Zweig, *Men in the Pits*, Left Book Club Edition, (1948), p 151.
[28]A R Griffin, *The British Coal Mining: Retrospect and Prospect*, (1977), p 43.
[29]*Colliery Guardian*, Vol LXXIII, 15 April 1897, p 733. From an article by Charles Latham, *'Coal Getting by Machinery'*.
[30]*Colliery Guardian*, Vol, CXXIX 22 May 1925,
p 1258, L J Barraclough in his paper, '*A Method of Machine Mining*' highlighted that conveyors meant easier work for the collier and gave him more time and opportunity to consider his own safety in the workplace .
[31]Data taken from table 4.1, p 153.
[32]N K Buxton, *The Economic Development of the British Coal Industry*, (1978), pp 139,140. R A Church, *The History of the British Coalmining Industry, Vol 3, 1830-1913: Victorian Pre-eminence,* (Oxford, 1986), pp 582,583
[33]G L Kerr, *Practical Coal Mining*, second edition, 1914, p 171.
[34]J Whiteside, *Regulating Danger: the Struggle for Mine Safety in the Rocky Mountain Coal Industry,* (Nebraska, USA, 1990), p 42.
[35]See chapter 4, p 175-176, for a fuller explanation of this phenomenon.
[36]Inspector of Mines Reports, 1935, Scottish Division, p 49.
[37]B Smith, *Seven Years in the Dark: A Miner's Life*, (Barr, Ayrshire, 1991), p 94.
[38]Whiteside, *Regulating Danger*, p 42.
[39]See Chapter 3 pp 115-117.
[40]B Elbaum & W Lazonick, 'The Decline of the British Economy: An Institutional Perspective,' *Journal of Economic History, (JEH)*, 44(2), (June 1984), pp 572-573
[41]W A Lewchuk, 'The Role of the British Government in the Spread of Scientific Management and Fordism in the Inter-war Years,' *(JEH)*, 44(2) (June 1984), p 360.
[42]Elbaum & Lazonick, *(JEH)*, pp 570-573.
[43]J McGoldrick, 'Crisis and the Division of Labour: Clydeside Shipbuilding in the Inter-war Period.' T Dickson(ed), *Capital and Class in Scotland*, (Glasgow, 1982).
[44]M W Kirby, *The British Coalmining Industry, 1870-1946*, (1977), p 190.
[45]See tables 2.3.5 to 2.3.10 in the appendix.,
[46]Calculated from data in tables 2.1.6, 2.3.9 in the appendix.
[47]Benson & Lloyd, *New Technology*, p 182.
[48]See table 2.3.9 in the appendix.,
[49]Benson & Lloyd, *New Technology*, p 57.
[50]Campbell, Colliery Mechanisation, *(SSLH)*, pp 41 & 42.
[51]Ibid, p 41.
[52]Ibid, p 41.
[53]J McKechnie & J.McGregor, *A Short History of the Scottish Coal Mining Industry*, (Glasgow, 1958), p 74.
[54]See table 2.1.6, p.
[55]See table 2.3.7 in the appendix.,
[56]Supple, *The History of the British Coal Industry,* p 382.
[57]N K Buxton, *The Economic Development of the British Coal Industry*, 1978, p 113. Also see A J Taylor's article, 'Labour Productivity and Technical

Innovation in the British Coal Industry, 1850-1914. *Economic History Review*, [*EHR*],Vol XIV, No 1, 1961, p 61.
[58]J Benson, *British Coalminers in the Nineteenth Century; A Social History*, 1989, p 23.
[59]D G Greasley, 'The Diffusion of a Technology: The Case of Machine Coal Cutting in Great Britain, 1900-1938', University of Liverpool, PhD thesis, 1979, from table 3.56, p 176.
[60]Ibid, as shown in tables 3.48 to 3.56, pp 172-176.
[61]Ibid, figures reproduced from data in table 3.58 pp 179-182.
[62]R Duncan, *Shotts Miners Conflicts and Struggles, 1919-1960*, (Motherwell, 1985), p 23.
[63]J H Goldthorpe, 'Technical Organisation as a Factor in Supervisor-Worker Conflict,' *British Journal of Sociology*, Vol X, No. 3, (1959), p 213.
[64]Ibid, p 223.
[65]J Zeitlin, 'Rank and Filism in British Labour History,' *International Review of Social History*, (*IRSH*),Vol 34, (1), (1989), pp 42 -61.
[66]Ibid, p 46.
[67]*Glasgow Herald*, from, articles between 29 July, 1911 and 10 November, 1911.
[68]J Hinton, *Labour and Socialism, A History of the British Labour Movement 1867-1974*, second edition, (Sussex, 1986), p 93.
[69]Page-Arnot, *History*, p 189.
[70]*Annual Report of His Majesty's Chief Inspector of Mines, 1930*, Division one-Scotland, p 41.

CHAPTER 2

The Economic Position.

In an effort to set the scene for this study this chapter will consider the effect of economic forces on the Scottish coal mining industry during the years 1890-1939. The section is divided into two distinct periods, the era prior to 1914 and the inter-war years. The first period was one of continuous growth for the industry whereas the twenties and thirties were years of depression and contraction. The first section will show the experience of the Scottish coal industry, both at county level and at national level in comparison to Britain as a whole. Areas such as markets, employment, output, productivity, prices, competition, labour relations and structure of the industry will be analysed. The impact of mechanisation on the economy of coal production will form a central theme of the study. The next section looks at the attitudes and policies of Scottish coal owners to technological change within their industry. Three prominent Scottish coal compamies and one of the main employers' association receive detailled analysis. In so doing it is hoped to determine whether Scottish coal masters adopted a progressive attitude to change or whether they can be accused of a failure of entrepreneurship as were so many of their contemporaries. In the final section a similar structure is followed as in the first part of the discourse but in this instance the main focus will be on the particular economic problems of the inter-war era. That is, the dislocation of trade caused by the Great War, growing competition from foreign producers and new energy sources and the problems caused by the depression. Attempts were made to counteract such difficulties, the main one being the Coal Mines Act of 1930, and these are investigated. As with the first section the continued and growing use of new technology in coal production methods forms a core element of the chapter.

I

The Economics of Coal Production, 1890-1914.

The quarter century prior to the outbreak of the First World War was a period of rapid expansion for the British coal industry. Coal output increased from 181.6 million tons in 1890 to an historic peak of 287.4 million tons in 1913. Numbers employed in coal mining also experienced continuous growth during these years rising from 632,800 to 1.13 million.[1] The main area of market growth for British producers in this era was exports. In 1890, 21.3 percent of total production, some 38.7 million tons, was exported. By the end of the period this had risen to 98.3 million tons which represented 34.2 percent of total British output.[2] When the value of exports is considered coal shipments abroad again performed well. In 1855 coal accounted for 3 percent of total exports, by 1910 this had risen to more than 10 percent.[3] The fortunes of the Scottish sector were similar to the national experience. However, this experience is sometimes afforded only scant attention or entirely subsumed within the historiography of the British coal industry. Consequently, a more detailed review of the economic position of Scottish mining, in the years 1890 to 1914, is warranted.

Markets.

In 1869, the iron and steel industry was the main market for Scottish coalmasters. Indeed, 30 percent of all coal produced was destined for that sector. By 1913, just 11 percent of total tonnage was consumed in the manufacture of iron and steel. The export industry, on the other hand, saw a reversal of this trend. That is, 9 percent of output was shipped abroad at the earlier date. This had risen to 32.5 percent in 1913.[4] The importance of the export market was highlighted by C M Percy in his inaugural address to the Wigan and District Mining and Technical School in 1902. Percy argued that one half of total output and the jobs of approximately 300,000 mineworkers, which was roughly 50 percent of the workforce, depended on foreign trade. He was not suggesting that half of British coal went abroad but he had calculated that to be the percentage used by the various sectors of British industry who also relied on foreign trade.[5]

Between 1870 and 1890, 40 percent of Scottish production was destined for the iron and steel and the overseas markets. This decreased to 30 percent in 1913 with exports the major market. Scotland increased her share of British coal exports between 1870 and 1913, rising from 11 to 14 percent. This growth in Scottish exports was commented on by A B McCosh (of Wm.Bairds Limited) in 1893 at the annual dinner of the Glasgow Colliery Representatives, when he noted that:

> One feature of the Scotch coal trade of the past few years which stood out and called for some remark was the great development of the export trade. In the years 1890, 1891, and 1892 more coal was exported than in 1889 by 10.8 percent, 14.9 percent and 24.31 percent, whereas the increase in exports from England and Wales in these years over their exports in 1889 were 1.5 percent, 5.5 percent, and 2.8 percent respectively.[6]

Thus, in the earlier part of the period under investigation the evidence indicates that Scottish producers were more dynamic than those in England and Wales.

An example of this dynamism can be found in the progressive marketing policies of the Fife Coal Company Limited. Throughout the nineties and in the early years of this century this company steadily built up their overseas markets. Much of this increased trade accrued because of the policy of paying closer attention to the needs of their customers. For example, a frequent complaint of continental customers, highlighted in consular reports, was that of shortages in weight and the amount of small coal found on arrival at the Baltic ports. The weight of Scottish coal, it was claimed, could be between 4 and 7 percent short on arrival compared with a 2 percent maximum shortfall in English shipments.[7] Charles Carlow, managing director of the Fife Coal Company Ltd., who had travelled to the continent to observe the unloading of Fife coal, negotiated, successfully, with the North British Railway Company on his return for improved coal waggons and for anti-breakage apparatus to be installed at Fife ports to resolve this situation.[8] Actions like these helped to expand overseas markets for Scottish coalmasters during this period.

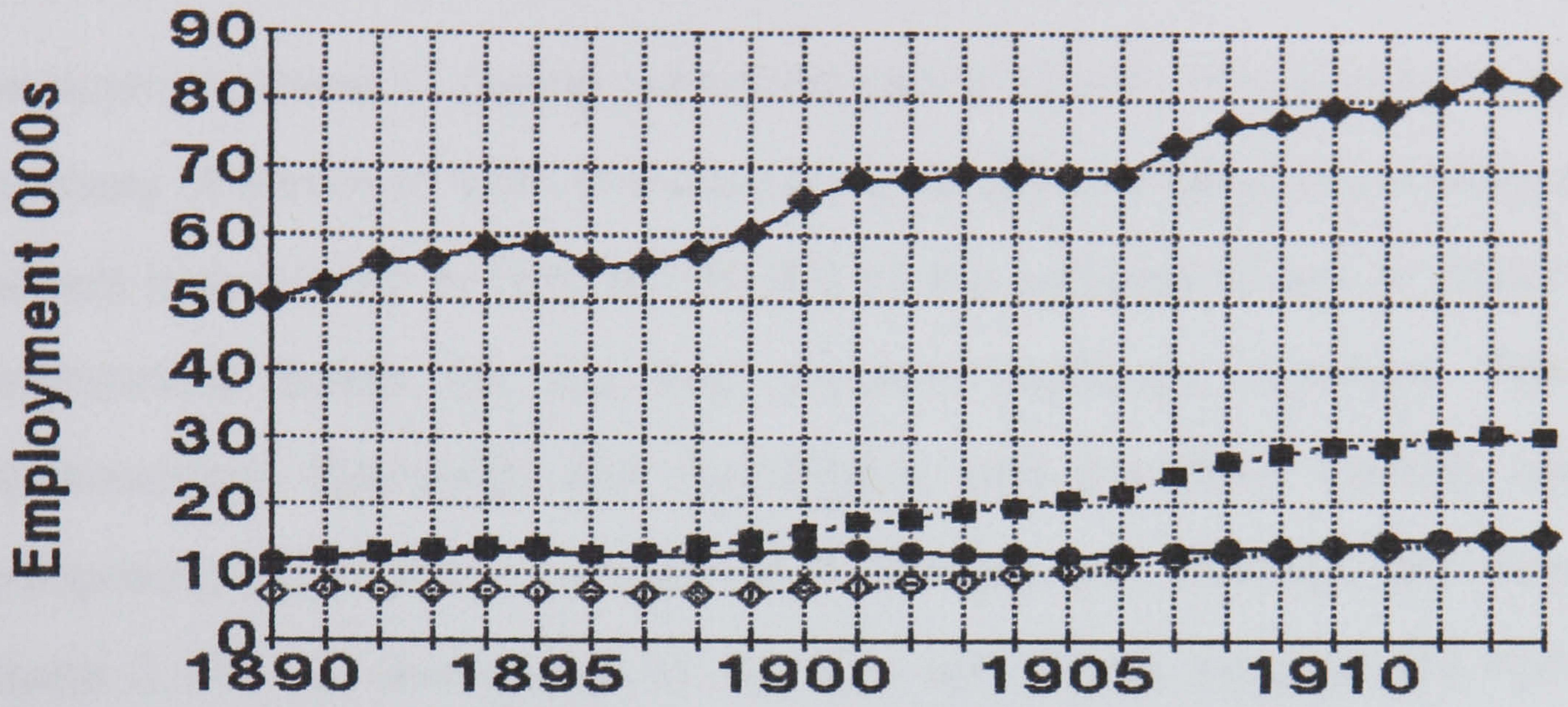
The expansion in shipments overseas meant that the Scottish coal trade, and in particular, trade in the eastern coalfields was more closely connected to the world economy and, consequently, subject to the vagaries of international markets. Taking this point into consideration it would be reasonable to assume that Scottish exports would have been adversely affected during the depression years of 1895/1896, 1905 and 1909. This, however, does not seem to have been the case. In both of the later trade downturns Scottish shipments witnessed an increase on previous years, 320,000 in 1905 and 862,000 in 1909.[9] It should be noted that in both instances the value of shipments had declined. Trade in the earlier depression did suffer but this seemed to be more as a result of the industrial unrest in 1894, that is, the four month "national" strike by Scottish colliers, than from the decline in world trade. Reference to the loss of confidence in Scottish suppliers by continental consumers was emphasised in reports by Consul Ward of Bordeaux. He argued that French manufacturers first turned to Lancashire for supplies and then switched to domestic coal which, Ward contended, would have long-term effects upon Scottish exports.[10]

Industrial unrest in 1912, which was the first national strike by British miners, also led to a decline in exports due to the uncertainty this caused abroad. This stoppage led to a reduction of 1.2 million tons in Scottish exports. A further decline of 140,000 tons throughout the remainder of that year is attributed to labour troubles at Scottish ports from dock labourers and seaman.[11] Balancing this out, however, was the fact that troubled labour relations abroad proved to be beneficial for Scottish coal producers. For example, a strike by Pennsylvannian miners and French miners in the Pays De Calais region in October and November of 1902, caused a rise in exports and enabled Scottish mineworkers to obtain an increase in wage rates due to the buoyancy of trade. Scottish shipments to the U.S.A. were 880,422 tons in 1902 which represented an increase of nearly 700 percent on the previous year. Scottish coal exporters also gained from the enhanced market opportunities created by the withdrawal of American coal from world markets.[12] Thus, gains as well as losses were derived from labour unrest during these years.

British exports came under pressure from foreign competition in many areas throughout the world in these years. At the start of the period Sir Charles Palmer made reference to the advantages German coal producers attained from lower wage costs and lower freight costs on German railways as a result of government subsidies.[13] State help to German producers is frequently referred to by British commentators throughout the period. Similarly, the infiltration of British markets abroad by the Westphalian Coal Syndicate also receives much attention. For instance, in 1905, growing concern was shown over the inroads being made by this group, not only in northern Europe but also in the Mediterranean.[14] At the beginning of this century British exports suffered from a coal tax, of one shilling per ton, imposed by Sir Michael Hicks-Beach, the Chancellor, to raise revenue for the war in South Africa. In 1902, The Scottish Coal Exporters Association canvassed Scottish M P's for action to reduce the damage this tax was having on shipments. They sought an exemption for "Scottish Nuts" - small coal, similar to that given to Welsh patent fuel, on the ground that the tax was destroying the valuable trade that had been built up with Germany and Scandanavia over the years. The Scots argued that exemption was all the more important because this grade of coal was otherwise unsaleable dross.[15] Several consular reports also saw the coal tax as a major disadvantage to British producers pointing out that there was a growing tendency for overseas producers to sacrifice size and quality for price, a fact that German coalmasters were quick to act upon.[16] The tax, or shilling bounty as it was known, was eventually removed in 1906.

Another factor which could effect the demand for exports was the seasonality of trade. Shipments were subjected to the vagaries of the weather. The export trade, particularly to the Baltic, was regulated by weather conditions, especially in the winter months. Shipments to northern Europe generally ceased, or were greatly reduced, between November and February each year. As well as reducing the tonnage shipped this often led to a decline in price for steam coal to due the slump in shipping. In 1892, for example, exports from Scottish ports increased owing to fair weather which prolonged trade to northern Europe. The following year, however, shipments suffered from harsh weather conditions. Baltic ports were still icebound in mid-April, this being especially detrimental to coalmasters in Fife and Clackmannan who relied on the Baltic region for much of their trade.[17] The domestic trade was also prone to seasonal fluctuations. Demand for house coal was also influenced by the weather, demand being highest in winter time. The demand from gas companies followed a comparable pattern to house coal. Thus, the vagaries of the weather impinged upon Scottish exports and her domestic trade, which affected employment levels and output in the industry.

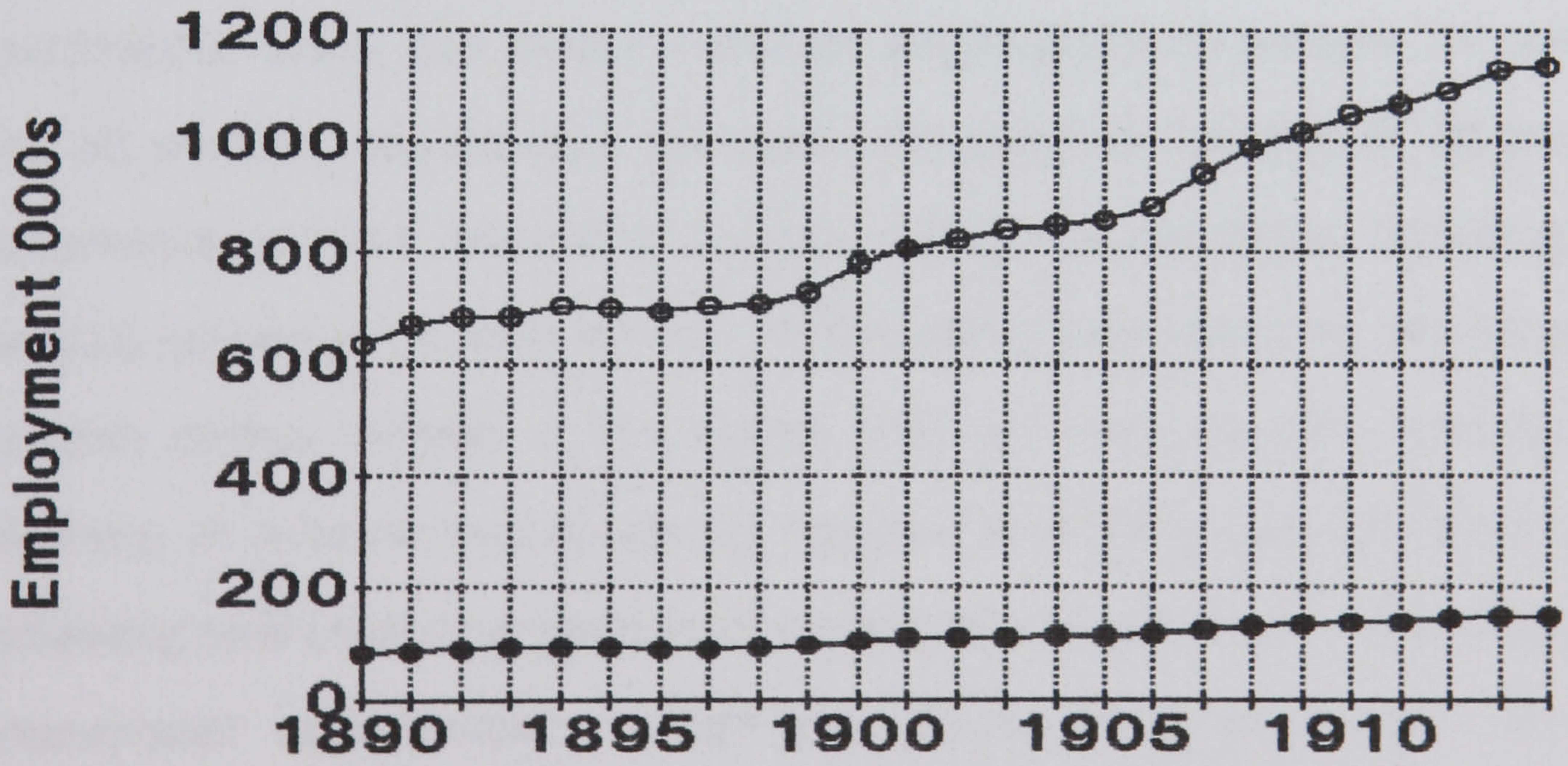
Figure 2.1.1 Employment
Scottish Coalfields, 1890-1914



Source: Tables 2.1.7-15

Ayrshire · Fife & Clackm · Edinburgh & H · West Central

Figure 2.1.2 Employment
Scottish and British Mines, 1890-1914



Source: Tables 2.1.16-17

Scotland · Great Britain

Employment and Output.

Employment levels in mining witnessed steady growth throughout this period. Numbers of miners in work in Scotland mirrored the national trend rising by 80 percent from 81,100 in 1890 to 146,200 by the outbreak of war in 1914.[18] The employment trends for the four Scottish coalfields, Ayrshire, Fife and Clackmannan, Edinburgh and Haddington, and the West Central coalfield (comprising Dumbarton, Lanarkshire, Linlithgow and Stirling), are shown in Figure 2.1.1. A comparison of Scottish and British employment trends is depicted in figure 2.1.2. Closer investigation of the Scottish trend, however, shows wide regional variations as the county breakdown in tables 2.1.7 – 2.1.17 in the appendix confirms. The data reveals that all areas witnessed an expansion in numbers employed with the exception of Clackmannan which experienced a decline of 8 percent. Several areas, Ayrshire, Dumbarton, and Lanarkshire, which saw rises in numbers employed of 30 percent, 37 percent, and 59 percent, respectively, fell below the Scottish average of 80 percent. Lanarkshire, in 1914, was still the biggest centre of employment, providing work for 40.6 percent of Scottish miners. At the earlier date, however, 46 percent of Scottish colliers worked in this district. Hence, these western districts were declining in relative importance as centres of employment for miners. The remaining coal producing districts all experienced absolute and relative gains in employment opportunities. Linlithgow, Stirlingshire, Edinburgh, Fife and Haddington saw increases of 85%, 95%, 105%, 205% and 260%. The Fife coalfield during this era provided increasing opportunities for mineworkers, this county's percentage of total Scottish mining jobs rising from 11.8 to 20 percent. These figures indicate that the eastern coalfields were beginning to erode the erstwhile dominance of the west as the main foci of employment in Scottish mining.

When the Scottish data is considered, figure 2.1.2, (table 2.1.16 in the appendix), it can be seen that employment levels grew in a fairly uniform manner. The upward trend is broken once, discounting 1914 the war year, that being in years 1895/1896. A similar break in growth is noted in the British statistics, table 2.1.17. Factors that help explain this fall in employment are economic downturn and the adverse affects of industrial unrest. The years 1895 and 1896 were troughs in the trade cycle, other low points occurring in 1905 and 1909.[19] The reason why employment levels at the earlier date were subjected to a decline are linked to the occurrence of major periods of industrial unrest in the industry, that is, the English strike in 1893 and the Scottish stoppage of 1894. The industry south of the border having had more time to recover from the stoppage accounting for the less extensive fall in employment. Furthermore, English producers had captured Scottish markets, foreign and domestic,[20] during the Scottish dispute, many of which they retained for several years. This dislocation of trade compounded problems for the Scottish mining industry at a time when the economy was already depressed. These factors, then, can account for the single downturn in an otherwise continuous period of growth.

Another reason suggested for this decline was the introduction of labour-saving machinery. Closer inspection of the data shows that a difference exists in the magnitude of the decline. A greater decrease in relative terms occurred in Scotland. Indeed, the British figure fell by just 2 percent whereas in Scotland the fall was 5.5 percent. An article in the *Colliery Guardian* in 1896 suggests that the introduction of new mining methods into Scottish pits was partly to blame for the higher rate of unemployment in Scottish coalfields:

> The total number of persons employed at and about coalmines [Scotland] decreased last year by 4956 persons. This is largely to be attributed to the introduction of machines into mines, and to the difficulty of finding full employment at the present unrenumerative rates for so large a number of persons.[21]

Scotland had traditionally adopted cutting machines more extensively than her outhern counterparts, for example in 1913, 22 percent of Scottish output was cut by machine. The corresponding figure for England and Wales for the same year was 6.2 percent.[22] If a correlation existed between levels of mechanisation and unemployment then this fact could explain the higher incidence of unemployment in Scottish coal mining. This hypothesis is investigated and developed more fully in chapter 3.

When coal production is considered it is found that output from British mines grew by 46 percent between 1890 and 1914. The Scottish experience was also one of growth. Indeed, Scottish output increased by 60 percent. As with employment wide regional diversities are encountered. Once again, the western districts, Ayrshire, Dumbarton, Lanarkshire and the eastern county of Clackmannan, although achieving overall increases of 30%, 39%, 20% and 16% respectively, declined in a relative sense. Coal producers in Stirling, Linlithgow, Fife, Edinburgh and Haddington who accomplished growths in tonnage produced of 78%, 139%, 165%, 256% and 269% attained much more favourable results. The predominance of Lanarkshire in coal production was, as with employment, under threat. In 1890 Lanarkshire, with an output of 13,584,800 tons accounted for 56 percent of Scottish tonnage. Twenty five years later this field, where output had risen to 16,247,400 tons, produced

Figure 2.1.3
Output Scottish Coalfields, 1890-1914

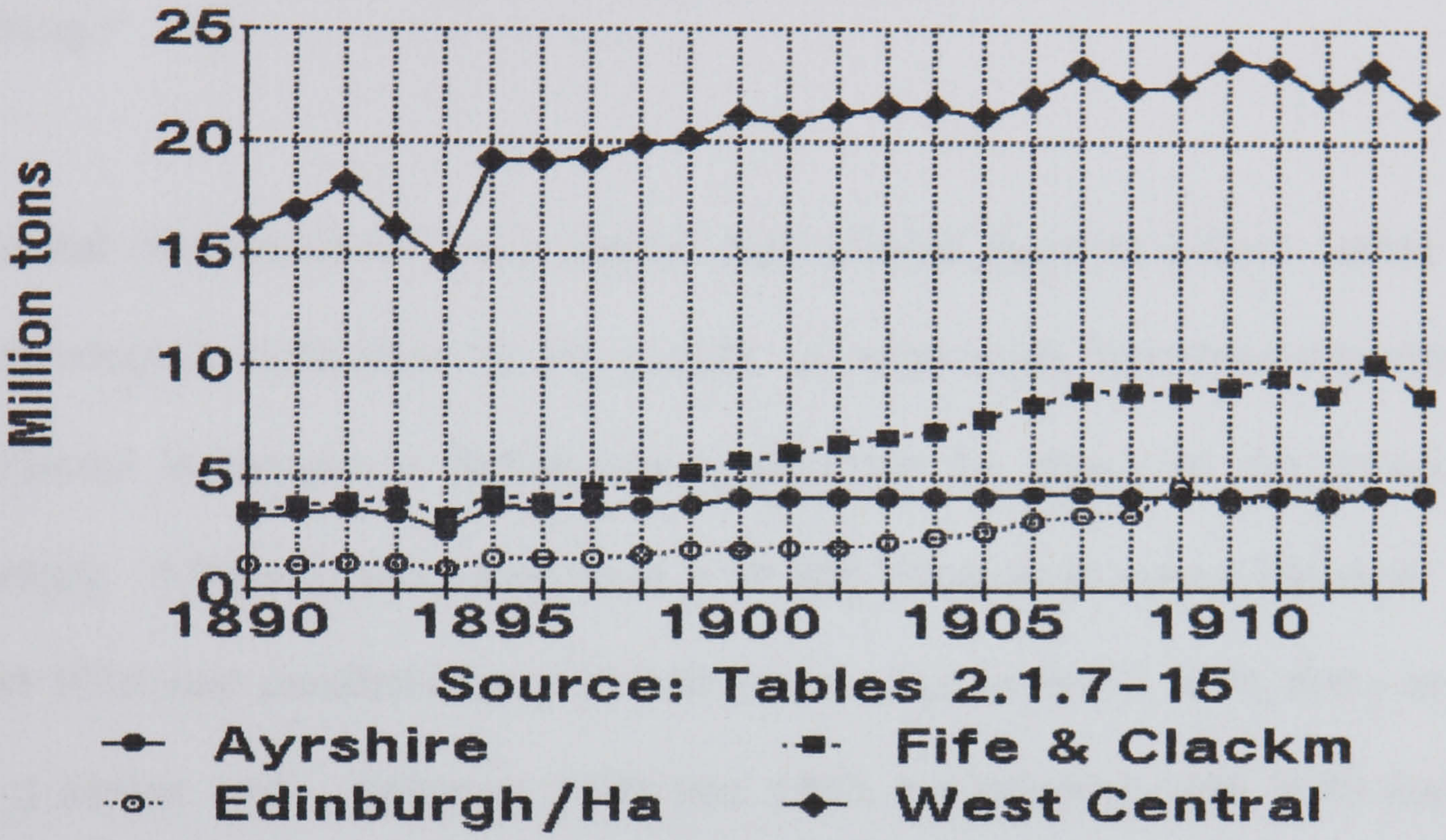
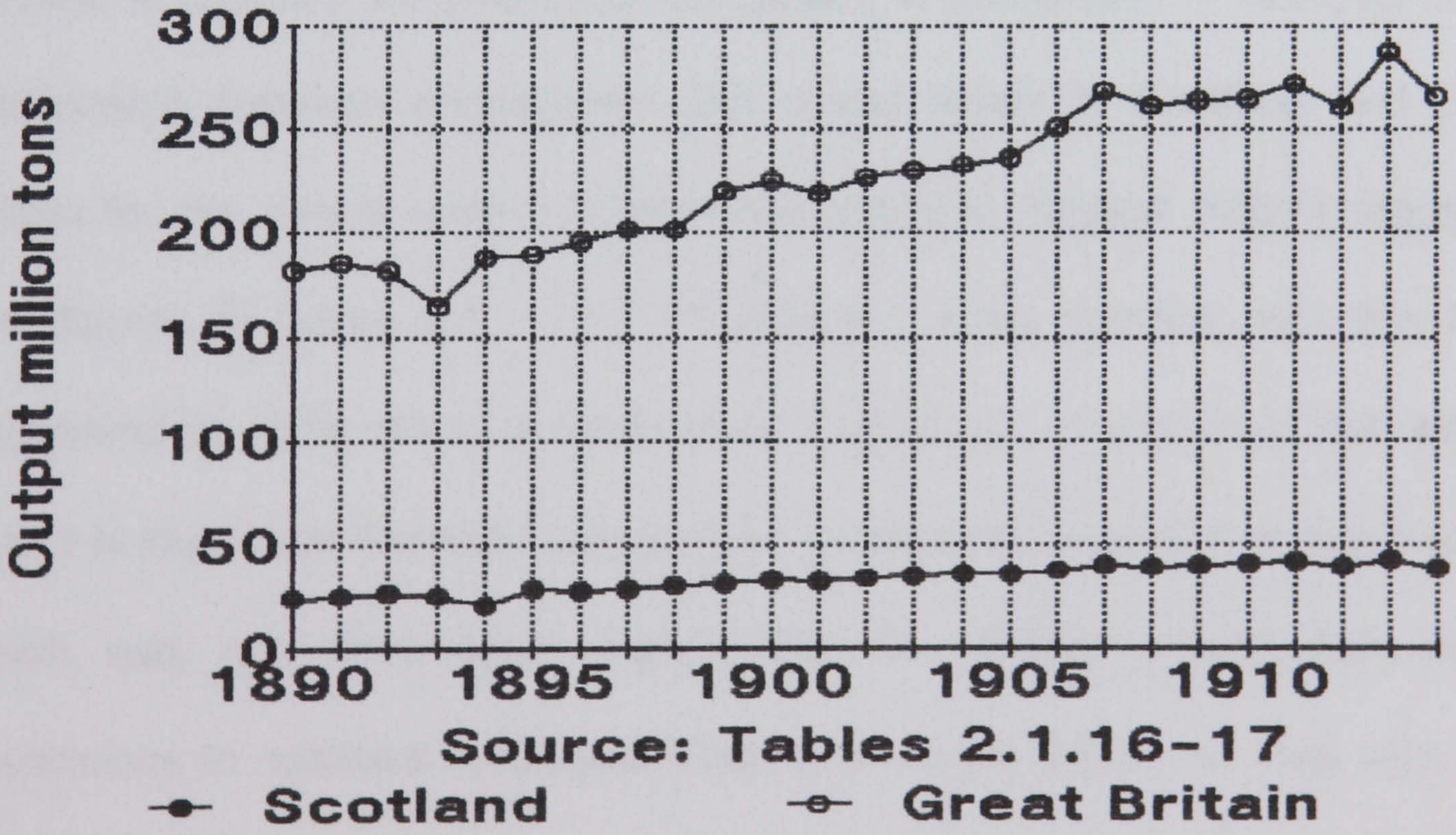


Figure 2.1.4 Output
Scottish and British Mines, 1890-1914



slightly less than 42 percent of Scottish coal.[23] The five eastern fields, above, increased their share of Scottish output by 17.7 percent during these years which further underlines the growing significance of the eastern field in Scottish mining.[24]

Several commentators have argued that greater input of labour rather than technological innovation or the growth of large-scale industrial organisation achieved increases in British coal production for much of the nineteenth century. J Benson has shown that a 28 fold increase in output between 1800 and 1913 was paralleled by a 25 fold rise in employment.[25] M W Kirby argues in a similar vein. Between 1889 and 1913, he indicates that a 60 percent growth in output resulted from increased labour levels. He states that a 90 percent expansion in underground workers and a 185 percent increase in surface employees accompanied the growth in production.[26] Analysis of the relationship between employment and output levels in Scotland and Great Britain for the period under consideration tends to support Kirby's argument. The figures in tables 2.1.1 - 2.1.11 however, while agreeing with the trend suggested by Kirby are of a much lower magnitude. Comparing both sets of data it is found that Scottish coal producers managed to achieve a rise in output which was one third again higher than the British growth with similar expansions in numbers employed. That is, while the British average was a 46 percent increase in tonnage produced for a 79 percent rise in mineworkers Scottish production was enhanced by 60 percent with 80 percent expansion in the mining workforce. Taking into account that some Scottish coal owners were forced to work their thinner seams sooner than English masters makes this all the more surprising.[27] A greater commitment to mechanisation in Scotland, as will be argued below, underpinned the Scottish achievement.

Productivity, Prices and Labour Disputes.

When investigating productivity in mining a guide to the trend can be found by dividing total output by total employment that produces output per man year (OMY). It must be stressed that this indicator is only a guide. It does not take into account the number of days or shifts worked in a year nor the length of shift. Time lost through absenteeism, strikes, lockouts or the "ca' canny"[28] tactic are also not included in the calculation. Using these variables output per man hour could be calculated which would provide a more accurate measure of productivity. Unfortunately reliable data on these parameters are not available for the time period in question.[29] Nevertheless, OMY does provide a method by which comparisons between districts are possible.

Figures 2.1.5 and 2.1.6[30] show the average OMY for Britain, Scotland and the Scottish regions. Comparing the Scottish and British data, and discounting 1893-4 which were years of major stoppages, it is noticed that Scotland always achieved a higher output per man per year than Britain. OMY for both countries fluctuate over the period yet the trend is practically identical for both

Figure 2.1.5
Output Per Manyear

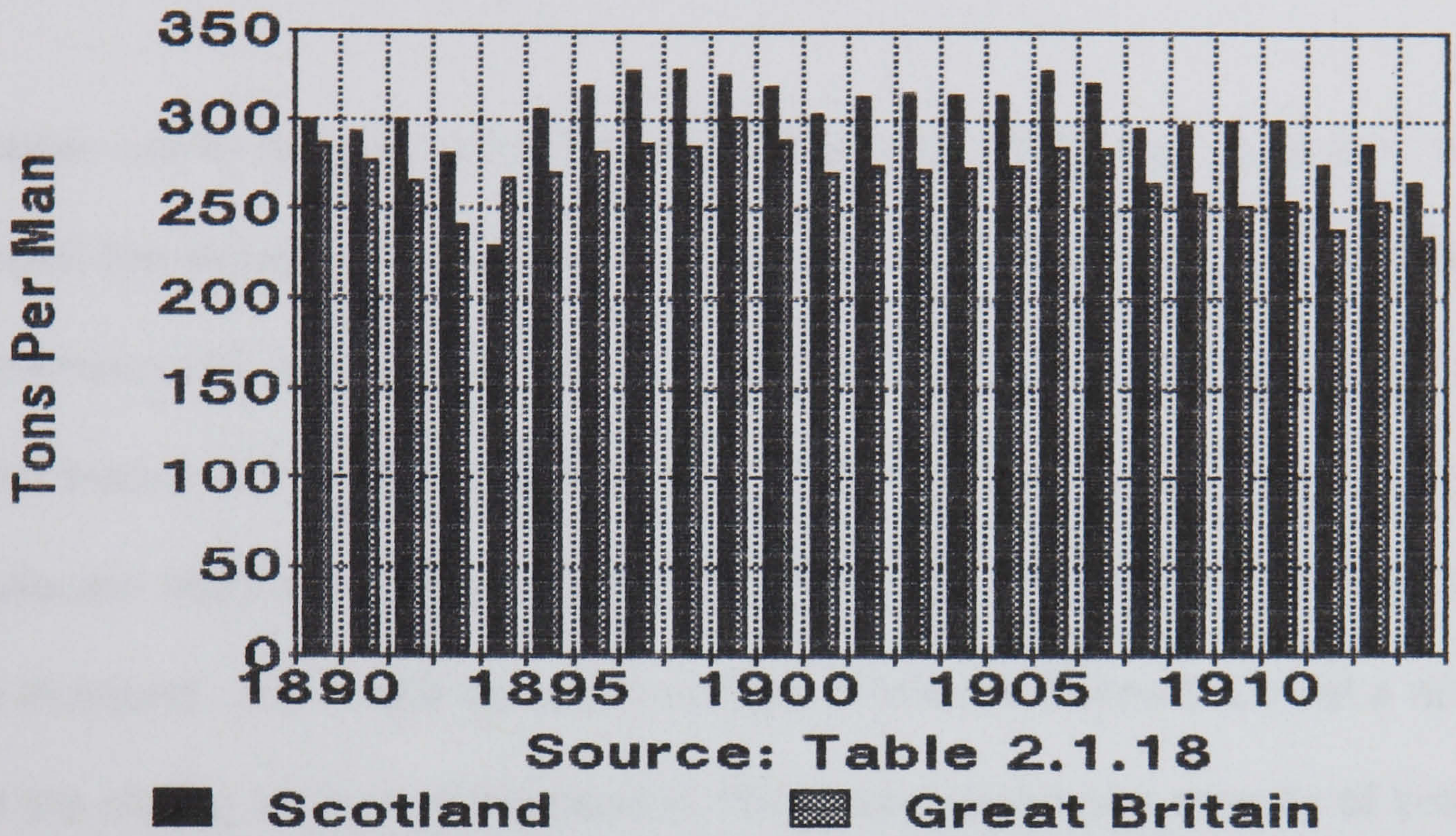
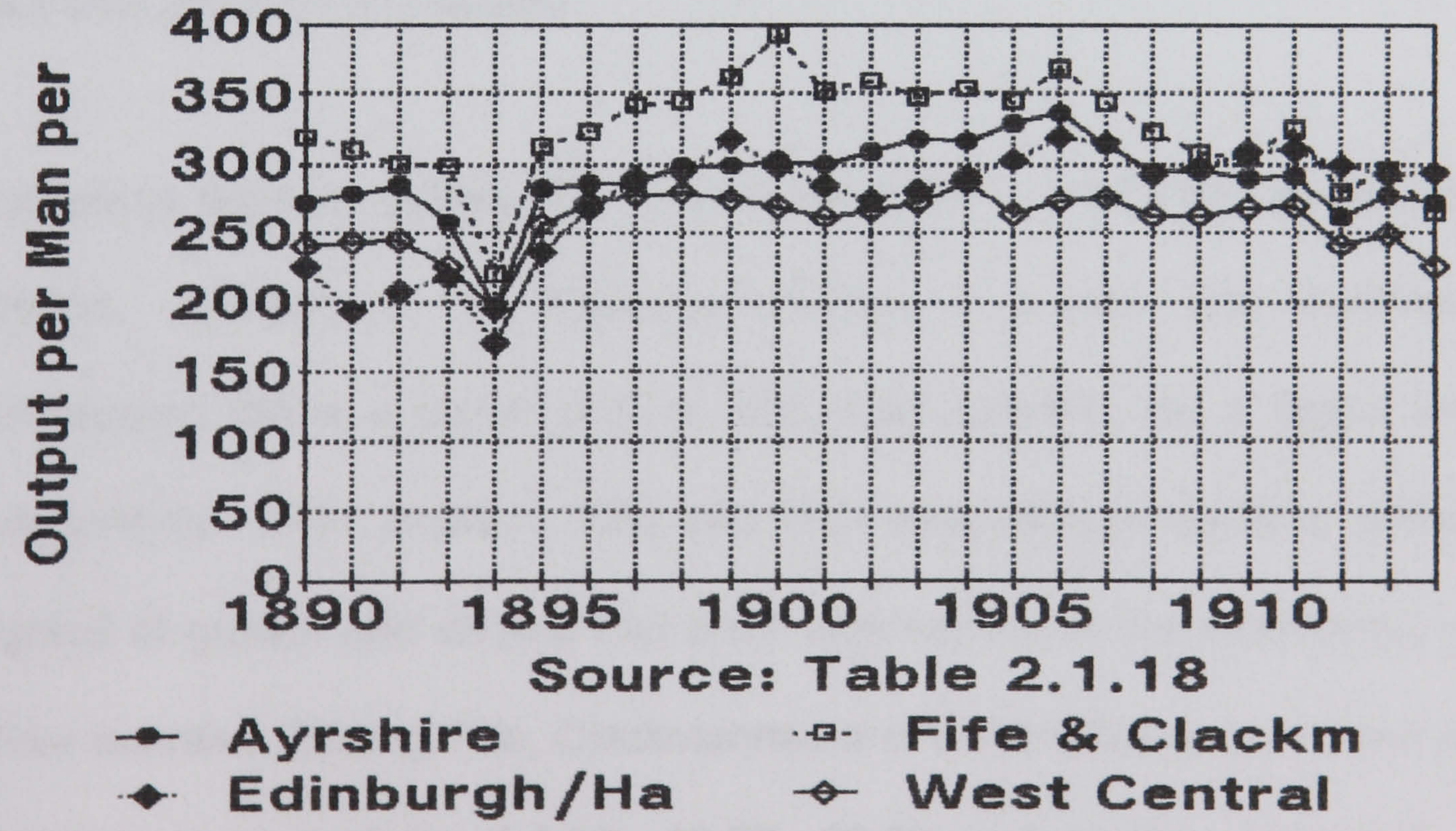


Figure 2.1.6
OMY Scottish Regions, 1890-1914



countries. The national trends being declines of 11.3 percent for Scotland and 19.5 percent for Britain. Productivity, then was declining, albeit at a slower rate in Scotland. Arguably, the greater propensity of machine mining practices in Scotland had an ameliorating effect on productivity.

Taylor contends one factor behind falling productivity was a dilution of skill within the industry. He states that, in 1901, 1 in 6 mineworkers had been in coalmining for less than two years.[31] OMY statistics for Britain seem to support this theory in that the biggest drop in British productivity, 31 tons, happened between 1899 and 1901. A scarcity of suitably qualified miners was also noted in Scotland. J T Forgie, general manager of William Bairds & Co., at a meeting of the Mining Institute of Scotland in 1903, complained of a scarcity of 'practical miners', by which he meant men who could hew coal from two foot seams as well as five foot seams.[32] A decline in skilled miners would have had an adverse effect on productivity.

Individual Scottish regions again exhibit variations in production levels over the period. Looking at the individual counties it is seen that Ayrshire and Dumbarton follow a similar pattern albeit that Ayrshire has a higher level of productivity. OMY levels in 1890 and 1914 were virtually identical although a period of growth and decline had been experienced in the intervening years. Four counties, Stirling, Fife, Clackmannan and Lanarkshire experienced overall declines in productivity of 8.3%, 13.2%, 20.3% and 24.2%, respectively. The Lothian coalfields, Haddington, Linlithgow and Edinburgh, on the other hand, increased productivity by 8.3%, 29% and 73%. Lanarkshire, once again, appears to be the area, which was loosing most ground.

One other element, which acted to reduce productivity in mining, was the additional overhead costs incurred as the working life of the pit increased. The longer a mine was in operation the greater the distance from the pitshaft to the coal face. This means more haulage, or on-cost, workers need to be employed, which increased overhead charges. The greater distances between shaft bottom and coal face also result in more non-productive time as the travelling time to and from the face is increased. More than 50 percent and possibly as much as 66 percent of coal produced in British collieries in 1914 came from mines which had been developed prior to 1875.[33] This would have had a marked effect on productivity. One factor influencing the decline in OMY in Lanarkshire was that thicker seams were nearing exhaustion. J S Dixon calculated in 1904 that only 45 percent of coal in Lanarkshire was in seams of 24 inches and upwards.[34] He also noted that output from the Lanarkshire coalfield had remained almost static for ten years whereas output in Fife had doubled and would continue to rise.[35] The greater factor costs involved in extracting coal from thin seams, coupled with the reasons above, were responsible for declining productivity in the Lanarkshire district.

Turning to prices, the data in table 2.1.1 show pithead prices during the period to have fluctuated widely but, not unsurprisingly, following the peaks and troughs of the trade cycle. Scottish prices were lower than the British average except at the height of the trade booms of 1900 and 1907 which is what would be expected of a region of lower wage costs. However, the graph shows that differences existed in pithead price trends between the Scottish and British averages throughout the course of the period.

TABLE 2.1.1 AVERAGE PITHEAD PRICES FOR COAL, 1890-1914

Year	Scotland		Gt Britain	
	s.	d.	s.	d.
1890	6	11	10	8
1891	6	5	8	1
1892	5	9	7	5
1893	5	9	7	2
1894	6	0	6	9
1895	5	4	6	2
1896	5	1	5	11
1897	5	3	6	0
1898	6	1	6	6
1899	7	6	7	9
1900	10	11	10	11
1901	7	11	9	4
1902	6	8	9	5
1903	6	3	7	10
1904	5	11	7	5
1905	5	9	7	2
1906	6	5	7	4
1907	8	10	8	10
1908	7	9	8	10
1909	6	8	8	0
1910	6	10	8	2
1911	6	8	8	3
1912	8	5	9	0
1913	9	8	10	10

Source: R Church, *The History of the British Coal Industry, Vol 3, 1830-1913, Victorian Pre-eminence,* (Oxford, 1986). Calculated from data in table 1.11, pp 58-59.

Although the iron and steel sector was declining in relative importance as a market for coal[36] at this time it was still a major source of demand. The depression in the metals sector in the early 90s was in great part, responsible for the sharp fall in prices in the year following 1890. Not only did this reduce direct demand it also increased supply as ironmasters, who were invariably coalmasters, put their coal supplies on the domestic market. Scottish prices suffered a less severe drop at this time, due to the quicker recovery of the metals industries north of the border.[37] Also exports from the Lothian fields were extremely brisk in the latter part of 1891. So much so that east coast shippers were willing to pay railway freights to bring coal from the West of Scotland because Lothian coal producers could not meet demand.[38] These two factors helped to reduce the severity of the fall in Scottish prices.

Labour disputes also affected price levels. Two major stoppages, the strike in the federated areas of England in 1893 and the 1894 strike in Scotland, impinged upon prices. The English dispute did not result in a rise in prices but the interruption to supplies did help to decelerate the fall in national prices. Scottish producers saw a rise in selling prices because of the English stoppage. The increase was not as great as it could have been because most of the contracts for the large users, for example, railway and gas companies, had been concluded earlier in the year when prices were lower.[39] The Scottish strike led to a modest rise in prices, 3^{d} over the year, mainly because the major customers went on short-time working or closed altogether. Indeed, by the seventh week of the four month strike there were only seven pig-iron blast furnaces in operation - 67 furnaces had been in blast at the same time the previous year.[40] House coal demand was high but as this accounted for just 15 percent[41] of the market and English merchants were adequately catering for this market, thus, price increases were minimal.

A strike by Welsh miners in 1898 also resulted in rising prices. Shipments from Scottish ports increased to the tune of 1.25 million tons because of this six months dispute.[42] This fact and the improving world economy helps explain the rapid acceleration in Scottish prices. The years 1910-1914 witnessed a major period of industrial unrest in Britain. Mineworkers staged their first ever national strike in 1912 and unrest at the docks and by seamen all combined to cause a sharp rise in coal prices. Coal owners, who were protected by strike clauses in their major contracts, took advantage of the high demand and elevated prices to offload stocks, much of which was very poor in quality. Industrial unrest in other countries also had an effect on prices. In some instances industrial unrest abroad, like the dispute by French dockers at Marseilles in 1904, meant a decline in Scottish prices owing to reduced exports, which increased supplies on the domestic market.[43] Conversely, the boost in the Scottish export trade in 1891 mentioned above owed much to industrial action on the continent by Belgian and German coalminers.[44] Thus, troubled industrial relations, at home and abroad, had both a positive and a negative effect on Scottish coal prices.

When the size and structure of the mining industry is examined differences are noticed between the Scottish sector and the rest of Britain. Table 2.1.2 depicts the size, by labour force, of mines in the Scottish regions and England and Wales in 1914. Looking at the Scottish averages it is apparent that 81.1 percent of collieries employed less than 500 workers. The corresponding situation in England and Wales being 71.2 percent. Indeed, the smaller size of Scottish mines has been viewed as a factor retarding growth. That is, there were too many small firms lacking sufficient capital resources, thus, incapable of instituting the technological and organisational restructuring necessary to maintain the industry's competitiveness.[45]

Benson noted, however, that mines in eastern Scotland were typically larger, in terms of numbers employed, than those in the western sector. The average eastern mine employed c.200 men in 1880. This rose to c.310 by 1914. Collieries in the western coalfields had average workforces of c.150, at the earlier date. The size of the average workforce had increased to c.250 by the outbreak of the Great War.[46] This represents increases of 55 percent and 66 percent respectively. Consequently, a move to larger concerns was underway. Also, when considering the smallest category of mines, those employing less than 50 workers, it should be stressed that 38.2 percent of mines in England and Wales fell within this group - double the percentage in Scotland. The greatest number of large collieries in Scotland, employing over 500 workers, were to be found in Edinburgh and Fife with 29.6 percent and 42.7 percent of mines falling into that category. In 1873 the ten largest concerns in the eastern district employed 29 percent of the workforce. This had grown to 45 percent by 1913 which was the highest rate of industrial concentration in Britain. The rate of concentration was most rapid between 1894 and 1913 when these ten companies almost doubled their output.[47] The process of industrial concentration among Scottish coal companies is investigated in more detail in section II.

The Fife Coal Company, established in 1872, provides a good example of this process of concentration. The company embarked on an ambitious expansion programme in the 1890s. To finance this expansion the concern 'went public' on the first of January, 1895. This firm then embarked on a series of takeovers, which saw seven rival coal producing companies being bought over by 1909.[48] The progressive managerial strategy[49] adopted by this concern resulted in it achieving the fastest rate of growth of all British mining companies through its policy of new sinkings and acquisitions.[50]

The western fields also had its share of large companies. In 1900, the Shotts Iron Company and Wm Dixon Ltd., had ten companies each, whereas Wm Baird and Company and Merry and Cunninghame each owned twenty two concerns.[51] Baird's was the third largest employer of miners in Britain in 1894, providing 7,405 jobs. The Fife Coal Company Ltd., with a workforce of 13,853, was the third largest employer in 1913 having pushed Baird's (11,408 miners), into fourth position.[52] Again, the rise of the eastern district is unmistakable.

TABLE 2.1. 2 SIZE OF SCOTTISH MINES BY LABOUR FORCE, 1914.

Nos Miners	Ayrshire		ClackMn.		Dumbarton		Edinburgh	
	a	b	a	b	a	b	a	b
1 - 49	18	18.5	0	0.0	3	27.3	2	7.4
50 - 99	27	27.8	2	33.3	0	0.0	4	14.8
100 - 499	49	50.5	4	66.6	7	63.6	13	48.1
500 - 999	3	3.1	0	0.0	1	9.1	4	14.8
1000 +	0	0.0	0	0.0	0	0.0	4	14.8
Total	97	99.9	6	99.9	11	100.0	27	99.9

Nos Miners	Fife		Haddington		Lanark		Linlithgow	
	a	b	a	b	a	b	a	b
1 - 49	6	9.8	1	9.0	49	23.0	5	10.2
50 - 99	1	1.6	1	9.0	36	16.9	7	14.3
100 - 499	28	45.9	7	63.6	80	37.6	32	65.3
500 - 999	21	34.4	2	18.0	42	19.7	5	10.2
1000 +	5	8.2	0	0.0	6	2.8	0	0.0
Total	61	99.9	11	99.6	213	100.0	49	100.0

Nos Miners	Stirling		Scotland		Eng & Wales	
	a	b	a	b	a	b
1 - 49	16	33.3	106	19.7	898	38.2
50 - 99	6	12.5	84	15.6	175	7.4
100 - 499	17	35.4	247	45.8	603	25.6
500 - 999	8	16.7	86	15.9	368	15.6
1000 +	1	2.1	16	3.0	308	13.1
Total	48	100.0	539	100.0	2352	99.9

a= No. Mines
b= % of Area

Source: List of Mines, 1914.
Note: Mines which were shown as having zero employees, for example, abandoned mines or those that were listed as sinking new pits or pumping stations have not been included in the above calculations.

Scotland also had a higher inter-regional ownership pattern than existed in England or Wales. More companies north of the Tweed owned mines scattered throughout the various mining counties. Wm Baird and Co., in 1914, controlled mines in seven different counties; Ayrshire, Dumbarton, Lanark, Linlithgow, Stirling, Renfrew, and Inverness. United Collieries Ltd., owned mines in four different areas and several companies worked pits in two and three different districts.[53] This is further indication of the advanced state of industrial concentration in Scottish mining.

When the company structure and shareholding pattern of mining companies is analysed change is again evident. The distribution of employment by type of firm is depicted in tables 2.1.3 and 2.1.4. In 1895, 25.8 percent of Scottish miners were employed in companies, which were engaged in the iron industry. 16.8 percent of colliers found work with public limited companies, whereas 21.8 percent were employed by private limited companies. Most mineworkers, just under 36 percent of the Scottish total, worked for unlimited companies, partnerships or proprietorships.

As can be seen from table 2.1.4, this structure had changed significantly by 1913. In that year the proportion of miners working for Scottish iron and coal concerns had fallen by 3 percent, but at 22.8 percent this was considerably higher than the British average. The percentage of workers employed by limited companies increased significantly. Private limited companies were now the biggest employers of colliers in Scotland. Some 38 percent of mineworkers worked for this type of concern. Just under 30 percent of miners worked for public limited companies. This was nearly double the national average. The greatest change was seen in the last group, unlimited companies, partnerships and proprietorships which declined from 35.6 to 9.5 percent bringing it just short of the national figure of 10.2 percent.

TABLE 2.1.3 DISTRIBUTION OF EMPLOYMENT BY TYPE OF FIRM, 1895 (%)

	Coal/Iron Co's	Public Ltd.,	Private Ltd.,	Unlimited, Partnership, Proprietorship
Scotland	25.8	16.8	21.8	35.6
North East	12.1	3.9	49.0	35.0
Cumberland	17.2	0.0	39.4	43.4
Lancs/Ches	8.4	11.8	50.1	29.7
N. Wales	1.4	11.0	66.4	21.1
Yorkshire	11.6	5.1	52.5	30.8
East Mids	25.9	5.0	36.7	32.5
West Mids	25.7	6.2	36.9	31.1
S. Wales	14.7	15.6	52.8	16.9
S. West	0.0	4.2	49.5	46.3
U.K.(Ave)	16.0	9.3	44.7	30.0

Source: R Church, *History of the British Coal Industry Vol III*, Table 2.10, p 140.

TABLE 2.1.4 DISTRIBUTION OF EMPLOYMENT BY TYPE OF FIRM, 1913 (%)

	Coal/Iron Co's	Public Ltd.,	Private Ltd.,	Unlimited, Partnership, Proprietorship
Scotland	22.8	29.8	38.0	9.5
North East	18.0	6.9	68.7	6.4
Cumberland	7.5	0.0	58.2	34.2
Lancs/Ches	7.1	13.7	66.4	12.8
N. Wales	0.0	1.3	84.9	13.8
Yorkshire	9.8	15.4	63.0	11.8
East Mids	26.1	2.4	55.3	16.2
West Mids	21.2	4.5	62.9	11.4
S. Wales	12.6	36.9	43.9	6.6
S. West	0.0	3.1	73.4	23.5
U.K.(Ave)	15.6	17.2	56.9	10.2

Source: R Church, '*History of the British Coal Industry Vol III*,' Table 2.10, p 140.

The high level of public limited companies in Scotland, second only to South Wales, has been linked to the expansion in the export sector.[54] The implication being that companies sought outside investment to finance expansion into lucrative export markets. Church argues that the low numbers employed in public companies by 1913 shows:

> This ownership structure is evidence of a lingering suspicion among contemporaries of the consequences of abandoning control of a firm's resources. When large amounts of cash were required either for major new capital projects or the acquisition of another colliery, calls were made to partners or shareholders' private wealth, which explains the limited contribution made by financial institutions and public shareholders.[55]

Although the biggest percentage of Scottish miners were employed by private limited companies in 1913, it should be emphasised that in comparison to other regions in Britain, Scotland had, by far the lowest ratio of firms with this type of company structure. Consequently, Scottish coal owners are shown in a favourable light.

Level of Mechanisation in Scottish Mines.

Scotland was also in the vanguard when technological innovation in mining methods are investigated. At the outbreak of World War I the Scottish sector was the most mechanised district within the British coal industry. Table 2.1.5 outlines the level of mechanisation in Scotland and in England and Wales for selected years between 1904 and 1913. The percentage of Scottish mines engaged in some form of mechanised production increased from 12 percent to

42 percent over these years. The situation in England and Wales, was also one of growth but from a lower base and at a slower rate, from 6.5 percent to slightly less than 16 percent. The ratio of machine cut coal increased *pari-passu* with the growth of coal cutters and at the latter date 22 percent of Scottish output and 6.2 percent of English and Welsh coal was machine cut by machine.

TABLE 2.1. 5 LEVEL OF MECHANISATION, SELECTED YEARS.

Scotland

Year	No. Mines using mach^y	No. of machines	Tonnage cut by machine	as % of total
1904	67	170	1,699,147	4.8
1905	72	211	2,171,282	6.1
1909	150	489	4,469,964	11.2
1910	168	581	5,873,455	14.2
1913	228	876	9,335,452	22.0

England & Wales

Year	No. Mines using mach^y	No. of machines	Tonnage cut by machine	as % of total
1904	182	585	4,044,899	2.1
1905	223	735	5,930,915	3.0
1909	270	1202	9,299,723	4.2
1910	264	1378	10,005,346	4.5
1913	448	2021	15,274,506	6.2

Source: *Colliery Guardian*,Vol XC, 1905, p 546,
Vol XCII 1906, p 812, Vol C, 1910, p 956, Vol CII, 1911
p 1251, and Vol CIX, 1915, p 231.

A regional picture of levels of mechanisation in Scotland in 1914 is provided in table 2.1.6. When the major centres of coalmining are studied Fife and Haddington stand out as the areas most predisposed to mechanised methods. Church contends that a link exists between the availability of electricity, the size of mines and the spread of machine mining methods.[56] Considering the distribution of electric power in Scottish mines there appears to be a link between this and pits that were heavily mechanised and as the majority of these pits were in the eastern coalfield, where mines were bigger on average, Church's argument appears valid.

TABLE 2.1.6 LEVEL OF MECHANISATION SCOTTISH REGIONS, 1914.

District	No. Mines	% using Electricity	% using Coal Cutters
Ayrshire	104	38.50	19.23
Clackmannan	6	100.00	50.00
Dumbarton	12	58.33	16.66
Dumfries	4	100.00	75.00
Edinburgh	27	85.19	40.74
Fife	61	80.32	70.49
Haddington	11	72.72	63.63
Lanarkshire	222	59.46	41.89
Linlithgow	51	60.78	19.60
Renfrew	8	37.50	0.00
Stirling	51	52.94	37.25
Inverness	1	100.00	0.00
Kinross	1	100.00	0.00

Source: List of Mines, 1914.

Figures 2.1.7 and 2.1.8 and table 2.1.19, appendix, show the level of mechanisation in Britain on an inter-district basis, for the years 1904 and 1913. Direct comparisons between the dates are problematic because of geographical changes to the districts throughout the period. Although, in the case of Scotland a direct comparison is possible because the boundary change simply consisted of merging the eastern and western fields. The difficulty arises when coalfields south of the border are considered. For example, coalmines in Derbyshire were included in the Midland district in 1904, but at the later date these pits came under the Yorkshire and North Midlands region, thus

Figure 2.1.7 Machine Cut Coal 1904

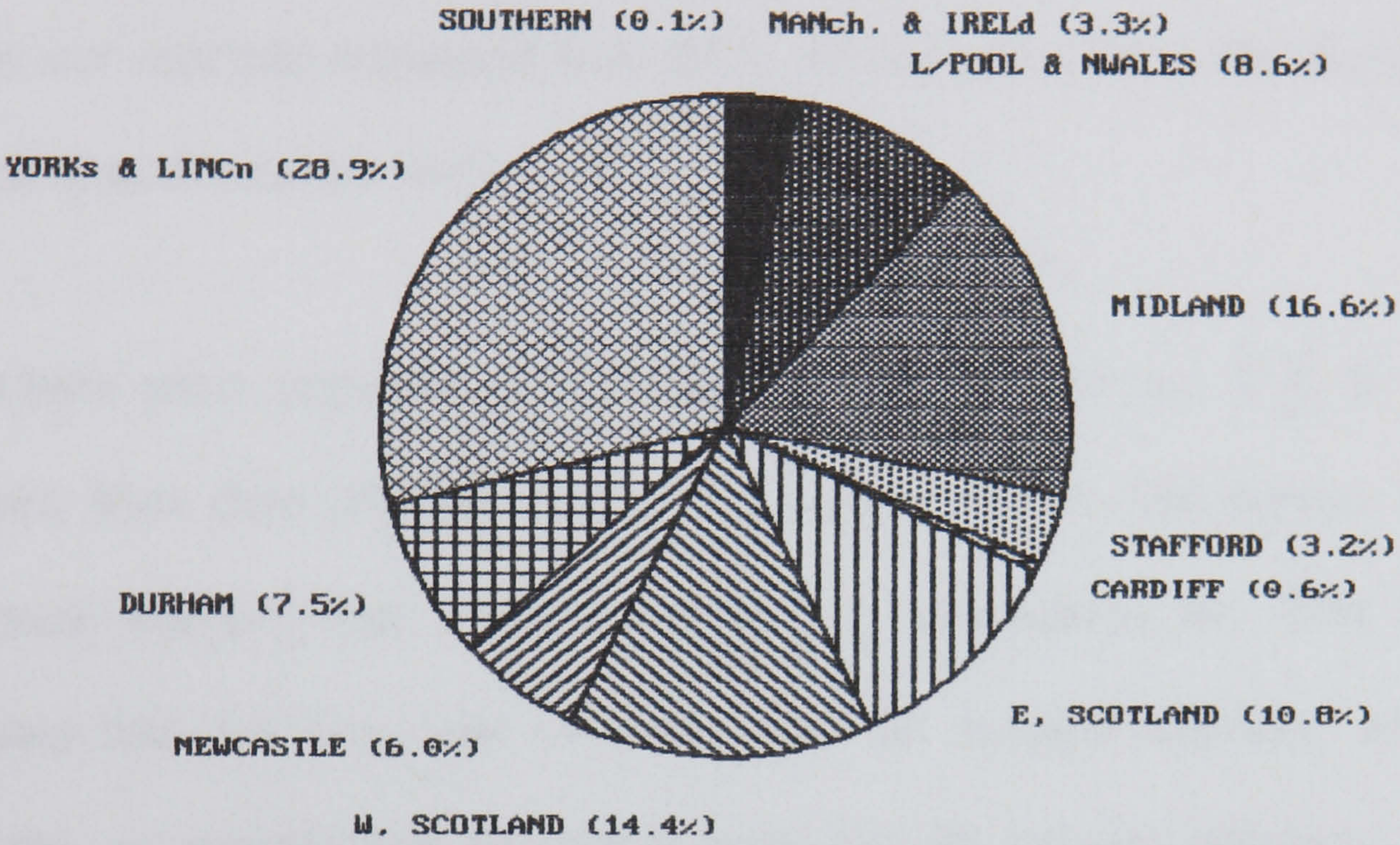
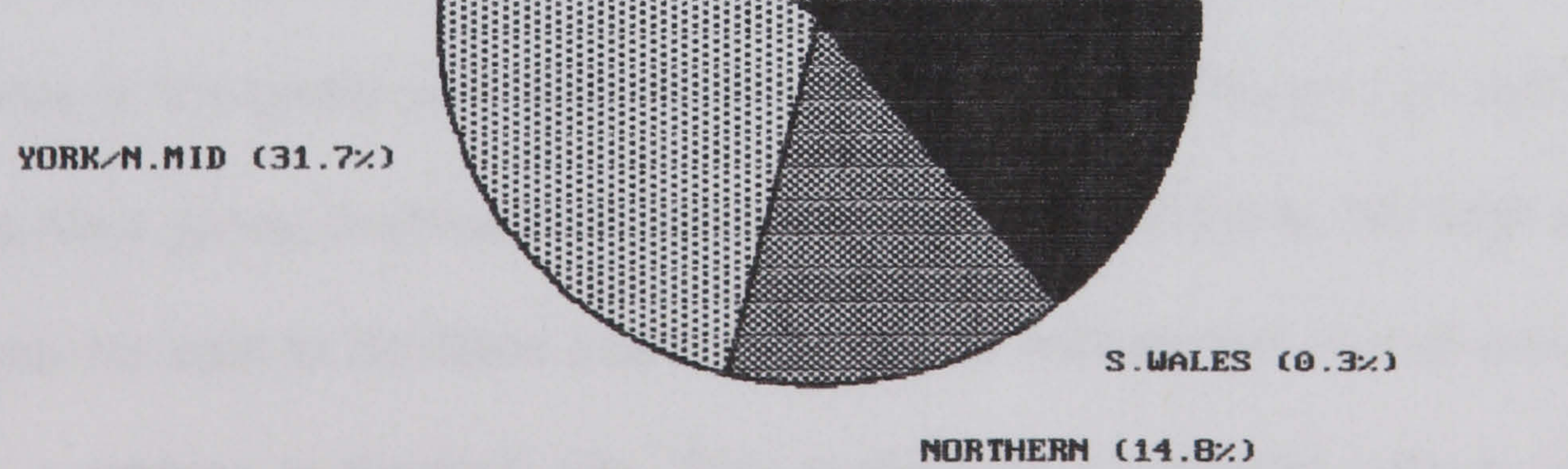


Fig 2.1.8 Machine Cut Coal 1913



Source: Table 2.1.19

comparative analysis over time is complex. Despite these difficulties Scotland's lead in mechanised coal production is clearly discernable. For instance, in 1904 the number of Scottish pits using coal cutters accounted for 27 percent of the British total. This had increased to 34 percent by 1913. Scotland's share of machine cut coal had increased from 29 to 38 percent making her the biggest producer of such coal by 1913.

Coal cutters were powered by electricity or compressed air. T B A Clarke estimated, from data gathered during four years of trials, that electric cutters were more efficient than those powered by compressed air. The results suggested that the first type of cutter was 55 percent efficient, whereas pneumatic, or compressed air cutters were just 27 percent efficient.[57] Table 2.1.19 outlines the quantity of each type used in the various regions.

The Yorkshire and North Midlands district and the Northern region had roughly the same overall number of cutters. The difference in output, however, was considerable. Numerous factors could influence the level of production, especially geological conditions. Nevertheless, the greater use of electric machines in Yorkshire and North Midlands, would have impinged on production quotas, thus giving credence to Clarke's estimations. Similarly, the high level of machine-cut coal in Scotland owed much to the widespread use of electrically driven machines in Scottish pits. This preference for electric cutters portrays Scottish coal owners in an extremely favourable light.

The reason most often cited for the greater diffusion of machine mining in Scotland is because that region suffered most from the tendency to diminishing returns.[58] That is, pits needed to be deeper, coal faces were receding further from the shafts and owners were forced to work their thinner coal seams sooner than most other British areas. This was an underlying reason for the expansion of coal-cutters in some areas in Scotland, for instance, in Lanarkshire. However, as has been shown earlier,[59] this does not explain the technological lead taken by Scottish coal masters in this period. Fifeshire was the most mechanised field of the main producing areas. This district, as has been argued above, was one which witnessed rapid expansion during these years, new fields were being explored and many new pits were being sunk - thus, owners would not have been subjected to the disadvantages of diminishing returns - quite the opposite. Fife coalmasters, it can be argued, resorted to new technology because they saw this as the most profitable way forward not solely because geological conditions compelled them to do so.

To sum up, it appears that the Scottish mining industry was, in many instances, more progressive than its counterparts in the south over the years 1890-1914. It has been shown that several areas in Scotland, predominantly in the eastern fields, achieved some of the highest productivity rates in Britain, witnessed the fastest rate of industrial concentration and had the highest ratio of inter-regional ownership. The ownership structure in Scotland was also progressive in nature, in that the growing percentage of public companies was among the highest in Britain, second only to those in South Wales. Scottish coalmasters were much more inclined to utilise machine mining techniques. Not only did Scottish coalmasters employ more coal cutters, the greatest majority of them being the more efficient electrically powered machines, but the level of mechanisation was increasing at a much faster pace than it was in England and Wales. This commitment to modern mining practices and progressive managerial policies, as displayed by companies like the Fife Coal Company Ltd., was an important factor behind the higher productivity levels in Scotland during these years.

Scottish Coal Entrepreneurs, 1890-1914.

The Scottish coalfields in 1913 were, by far, the most mechanised sector of the British coal mining industry. Indeed, 228 of the 542 mines in Scotland in that year, some 42 percent, were using coal cutting machinery compared with 16 percent of pits in England and Wales. Machine-cut tonnage in Scotland was 9.3 million tons, which represented 22 percent of the annual output. The English and Welsh total of mechanically cut coal accounted for just 6.2 percent of the yearly total.[60] Taken at face value this data suggests that coal masters north of the border were amongst the most progressive in the country when the introduction of modern mining methods is considered. To substantiate this claim several Scottish coal mining companies will now be investigated in some depth. The role of one of the main employer's associations, the Lanarkshire Coal Masters' Association will also be scrutinised in an attempt to establish whether a modernising ethos existed at a level wider than that of individual companies.

The Fife Coal Company could be regarded as one of the most innovative coal producing concerns in Britain during this period. The first general meeting of the company took place on 8 January 1873, and from the outset this firm displayed evidence of its progressive nature. Charles Carlow, the works manager, installed a mechanised haulage system at the Kelty No. 1 pit. In 1884 he was responsible for introducing a coal washing machine which he had travelled to Germany to see in operation before making the purchase.[61] Unfortunately the annual reports and directors minutes of this company have not survived, however, the level of mechanisation can, to some extent, be ascertained from data contained in the List of Mines, produced annually by the Home Office. Table 2.2.1, below, shows the growth of the company in terms of numbers employed and numbers of mines. From 1904 pits which used coal cutting machines are also recorded.[62]

TABLE 2.2.1 LEVEL OF EMPLOYMENT AND MECHANISATION, FIFE COAL Co. Ltd., SELECTED YEARS,

Year	No.Mines	No.using Cutters	Nos. Employed
1900	10	-	4931
1904	14	5	5968
1905	15	5	6577
1906	15	7	6574
1912	23	18	13499
1914	23	21	13860

Source: List of Mines, 1900-1914.

The Fife coalfield was the most mechanised area in Scotland at the outbreak of the Great War. 43 of the 61 mines in the county were engaged in machine mining.[63] Table 2.2.1 shows that mines belonging to the Fife Coal Company Ltd., accounted for just under half of all mines using coal cutters in 1914. Thus in terms of the diffusion of cutting machinery this company can be regarded as one of the prime movers in the Scottish mining industry.

The Fife Coal Company also exhibited innovative flair in its organisational strategies. It embarked on an ambitious expansion programme in the 1890s. To finance this expansion the concern 'went public' on the 1 January, 1895. The new company was formed with an authorised capital of £360,000 in 12,000 preference and 24,000 ordinary shares of £10 each.[64] This firm took control of the Cowdenbeath Coal Company in 1896, Lochore and Capledrae Cannel Coal Company in 1900, the Fife and Kinross Coal Company and the Blairadam Colliery in 1901, the Rosewell Gas Coal Company in 1905, Donibristle Colliery Company in 1908 and the Bowhill Coal Company in 1909.[65]

Growth through take-over and technological and organisational innovation was the hallmark of this enterprise. Between 1873 and 1913 the "Fife" retained at least 50 percent of net profits for re-investment putting it among the top five companies in Britain to do so. The progressive managerial strategy[66] adopted by this concern resulted in it achieving the fastest rate of growth of all British mining companies through its policy of new sinkings and acquisitions.[67] As a result of these technological and organisational innovations the output of the company increased from c.2 million tons in 1900 to slightly less than 4.4 million tons by 1911.[68] In 1913 this firm employed just less than half of all mineworkers in the Fife coalfield and it was the third largest employer in the British mining industry.[69] On this evidence the Fife Coal Company Ltd., can be seen as a

Scottish producer whose progressive managerial policies underlined its commitment to modern mining practices.

Another Fifeshire coal company, the Lochgelly Iron and Coal Company, also appears to have been committed to the modernisation of its enterprise through the adoption of new technology and organisational change. Fortunately in this instance several important company records have endured the ravages of time which allow a more detailed picture of this firm's attitudes and strategies to innovatory change. Minute books of director's meetings for the years 1891-1906 have survived which provide a detailed insight into the business plans and management strategies of the board. These can be supplemented with agenda books for the years 1906-1918 which are, admittedly, less detailed than the minute books but are still depositories of crucial business information.

Evidence of the modernisation programme of the firm can be found in the early 1890s. The erection of coal cleaning or washing plants and shaking screens, for cleaning and grading coals, resulted in significant capital expenditure for the company during these years. Outlay on this type of technology was necessary because customer requirements, due to increased competition, had become more sophisticated. If markets were to be maintained and extended the installation of modern techniques was paramount to the firm's survival.

Screening and coal cleaning machines for the Mary pit at a cost of £1,200 was authorised in 1892.[70] In 1901, a similar washing plant capable of processing

300 tons per day was sanctioned for the Little Raith colliery.[71] One year later a new screening and washing plant, at a cost of £12,000 was installed at the Minto mine. In 1903, a further screening plant for the Mary pit, £2,700, and a new screening and washing plant costing £10,300 was installed at the Nellie mine. This system was also to cover the processing of small coal from the Melgund and Jenny Grey pits.[72] Electric lighting was installed in several pits throughout this period the earliest reference being for the Gordon pit in 1894.[73] Consequently, it seems that market conditions and demands were the motivating forces which underlay the modernisation policies of the Lochgelly Iron and Coal Company.

A guide to the growth of mechanisation in the Lochgelly Company's mines is shown in table 2.2.2. The table indicates an increase in the use of mechanical coal cutters from 1905, when they are recorded as being in operation only at the Minto pit, to 1912 when 100 percent adoption was achieved. Indeed, if both the Lochgelly Iron and Coal Company Ltd., and the Fife Coal Company Ltd., are considered it should be noted that these two firms accounted for 70 percent of all mines in Fife using cutters in 1912.[74] This, again, underlines the high level of commitment to mechanised mining methods within these companies.

TABLE 2.2.2 LEVEL OF EMPLOYMENT AND MECHANISATION, LOCHGELLY IRON & COAL COMPANY Ltd., SELECTED YEARS.

Year	No.Mines	No.using Cutters	Nos. Employed
1900	2	-	1590
1904	5	0	1963
1905	6	1	2261
1906	6	1	2729
1912	6	6	4170
1914	6 (11 pits)	6	4063

Source: List of Mines, 1900-1914.

The minute books confirm that the first coal cutter was purchased in 1905 at a cost of £500.[75] The records show that between 1905 and 1912 the Lochgelly company purchased at least sixteen cutting machines. Approximately equal numbers of bar and disc machines were acquired at an average cost of £350.[76] The company also introduced the latest technology in the transporting of coal underground in the form of conveyors, several of which were purchased for the Mary and Minto pits.[77]

Several of the coal cutters were bought from the Anderson Boyes Company of Motherwell. Indeed, reference was made in January 1906, that the works committee had been authorised to purchase two machines from this firm providing that trials of the cutters at the mine were satisfactory.[78] The practice of Anderson Boyes in offering their machines and operatives for a limited period was, as Carvil has noted, a successful part of their marketing strategy. Anderson Boyes directors would install the machines and give instruction on how to operate them successfully.[79] The Lochgelly company's Agenda book for 1905-8 notes that courses were run at the Minto mine in 1907 for the men who worked coal cutting machines.[80] It does not state whether this course was run by the Anderson Boyes Company but it is reasonable to assume that it would have been this firm or one of the other coal cutting machine manufacturers, either Mavor Coulson or the Belhaven Engineering Company. These facts and the reference to the need for a qualified electrical engineer[81] indicate how the introduction of new technology necessitated the acquisition of new skills for both mineworkers and mine management.

The decision by the board in 1902 to appoint a Works Committee,[82] whose primary function was to be responsible for co-ordinating all new work is an indication of the company's commitment to achieving the highest standards through the adoption of new technology and organisational change. This committee was run under the dual leadership of W Thorneycroft and G A Mitchell, two individuals who also held prominent positions in the Lanarkshire Coal Masters' Association through their connection with the Plean Colliery Company Ltd., and Kerr and Mitchell.

Two years later, 1904, the capital outlay for the sinking and equipping of new pits and the refitting of older mines was £112,524 (£31,065 of this sum was for work and equipment which had been ordered but was still to be paid.) A further £36,000 worth of work had been agreed upon but was yet to be initiated. When these improvements were completed they would result in a daily output of 5,000 tons - doubling the previous rate. The expansion of Minto would provide a supply of navigation coal, which would enable the company to break into new, more lucrative markets. These new markets would also provide opportunities for the other classes of coal produced at Lochgelly.[83] The dynamism exhibited by this group of employers and their management teams is further proof that Lochgelly Iron and Coal Company was committed to moving forward through the adoption of the latest techniques both organisational and technological.

To finance such innovative changes required considerable capital outlay, much more than could be raised through the normal channels, that is resorting to the shareholders' private wealth. As a result the old Lochgelly Iron and Coal Company was wound up in 1896 and the new Lochgelly Iron and Coal Company Ltd., was floated on the Glasgow Stock Exchange in November of that year.[84] Five years later, November 1901, 3,000 Preference shares and 1,500 Ordinary shares, both at £10 were issued to finance further expansion. This brought the paid up capital of the company to £210,000.[85] Modernisation plans resulted in a further issue of shares to raise the capital of the company by £100,000 in 1905.[86] Church has commented upon the limited contributions of financial institutions in the development of the British coal industry arguing that this is indicative of coal owners unwillingness to abandon control of their businesses.[87] The Lochgelly owners, from the above evidence, should not be included in this oft-condemned group of entrepreneurs.

William Baird and Company Ltd., appear to have had a somewhat inconsistent attitude to the introduction of coal cutting technology. This firm was one of the pioneers in machine mining technology. Bairds took out the patent for their '*Gartsherrie*' machine in 1872.[88] This machine was based on an earlier model designed by Peter Gledhill and Peter Heggie in 1864. Bairds bought the patent for this cutter in 1866 and bought Gledhill out three years later. This machine underwent several modifications by John Alexander, which resulted in the 'Gartsherrie machine.' Initially the company had these cutters manufactured under licence by Miller and Anderson. However owing to the great interest shown by other coal producers Bairds decided to build their own engineering works to produce the machines themselves.[89]

From this pioneering stance William Baird and Company Ltd., as Corrins argues, seem to have abandoned coal cutting in the 1890s and did not return to this method of extracting coal for a further twenty years. Among the reasons for this abandonment cited by Corrins was labour opposition.[90] Yet it has not been substantiated whether the miners were opposed to machinery *per se*, or whether their opposition stemmed from other factors connected with the modernisation of mining. However, a further contention by Corrins that steadily rising output coupled with a rapid fall in wages post 1874 combined to remove the dual factors of high costs and restricted output which underpinned demand for coal cutting in the first instance appears to be a more credible explanation for Bairds withdrawal from machine mining methods.[91]

An investigation of valuation books belonging to Bairds confirms that coal cutters were in use at several of the company's pits during the decade following 1871, the pits in question being Espieside numbers 1 and 2, Banwood, Cairnhill, Luckwood and Bothwell Park numbers 1 and 2. The highest level of output was achieved in 1879 when 48,076 tons were produced by mechanised means.[92] The valuation book covering the year 1881-2 notes that all machines were on the pit bank which would suggest that Bairds had forsaken machine mining in favour of hand hewing. Furthermore, no mention of coal cutters appears in the succeeding valuation books which cover the period up to 1914.[93] If this source is to be believed then it does seem that Bairds had abandoned mechanised cutting for a considerable time in the years prior to 1914.

However, information in the List of Mines indicates that coal cutters were in operation in 8 of Baird's 44 mines in 1912, 4 in Ayrshire, 3 in Lanarkshire and 1 in the Stirling coalfield. Two years later machine mining was being pursued in 12 of the 50 mines that Bairds worked in that year.[94] Furthermore, an agreement had been reached at a directors' meeting in 1903 for the erection of an engine and electric machinery for coal cutting at Eglington at a cost of £3,000. It seems then that this firm was re-engaged in mechanical coal cutting somewhat earlier than Corrins suggests.

Regarding the absence of any mention of coal cutting machines in the valuation books for the period 1882-1914 it is possible that this is the result of a change in accounting practice. An inventory book for the later period, 1925-1933, contains detailed information on, not only the number but also the type of machines that were in use at the various pits.[95] Unfortunately this appears to be the only surviving inventory book of this type. Owing to the paucity of surviving data it is impossible to get an accurate picture of the level of mechanisation for the earlier period. Also, because of the anomalies in the recording of the use of coal cutters in the western district of Scotland prior to 1910, as commented upon earlier, the List of Mines is of little use for these earlier years because most of Baird's mines were in the western district. Despite these problems, however, to argue that Bairds were engaged in coal cutting by mechanical means by 1910-14 seems justified.

That this company embarked on an extensive modernisation programme from the end of the last century is indisputable. To finance this expansion new shares were issued on several occasions and, on at least one occasion, the directors were asked to make a loan to the company. In 1898 it was decided by the board to increase the capital of the company to £1 million through an issue of 20,000 £10 shares, to be taken by the existing board members.[96] At an extra-ordinary general meeting in August 1905 it was decided to raise a further £200,000 through a share issue, the directors of the firm again taking up these shares in proportion to their existing holdings.[97] Two years later the directors were asked to make a loan to the company of £100,000 repayable in 1919.[98] Just before the outbreak of the Great War the board decided to increase the share capital to £1.7 million by issuing a further 20,000 £10 shares.[99]

An example of the sums of capital assigned for modernisation is the £203,000 authorised in 1904 for various new works and improvements to be carried out in the period 1904-1909. More than one third of this capital being allocated to the Barony mine in Ayrshire.[100] One of the benefits accrued from large-scale, capitally intensive mines was improved productivity. The output per man year (OMY) achieved at the Bothwell Park collieries from 1897 to 1911 was consistently higher than the British average. Indeed, productivity at this particular colliery ranged from 31 percent to 38 percent above the national average.[101] Moreover, these figures understate the true level of productivity because they include a significant number of ironstone miners along with the colliers. OMY is calculated by dividing the total annual output by the total number of mineworkers and because the ironstone miners form part of the calculation the OMY is, therefore an underestimation. The fruits of this extensive investment programme are also to be found in the rising production levels achieved by Bairds in this era. Indeed, in the twenty five period following 1890 the total output of the William Baird Company Ltd., increased 100 fold from 752,102 tons to 1,577,140 tons.[102]

This case study of the William Baird Company Ltd., has thrown up a few differences from the first two companies investigated. The company structure of Bairds was that of a private limited company. This meant that although shares were issued their distribution was limited to the existing shareholders. It can be argued that this type of ownership structure can limit modernisation or expansion because the finance needed for such projects is tied to the private assets of the individual shareholders. Considering the extensive expansion plans undertaken by Bairds this type of ownership structure does not seem to have constrained this firm's dynamism in this period. However, on the downside, although a case has been made for Bairds employing coal cutting machines earlier than other sources suggest it still has to be conceded that this concern had a much lower proportion of its pits involved in machine mining than the previous two coal companies studied. Whereas the Lochgelly Iron and Coal Company Ltd., used cutters in all its pits in 1914 and the Fife Coal Company

Ltd., employed cutting machines in 91 percent of its mines, Bairds utilised machine cutting in just 25 percent of their mines. Perhaps a difference in attitudes and strategies toward modernisation existed between coalmasters in the eastern and western coalfields of Scotland? A study of the Lanarkshire Coal Masters' Association should help show if this apparent slow adoption of new technology was a common trait among western coal producers or whether it was particular to the Baird company.

Investigation of the attitudes and strategies of the Lanarkshire Coal Masters' Association to modernisation shows there is little evidence that this body pursued an active, evangelising role for the introduction of technological or organisational innovation within the industry. Nonetheless, as can be seen in table 2.2.3, the association's membership included the majority of the most highly mechanised pits in the county. In April 1912 the LCMA had a membership of 39. 25 of these firms have been identified and all but three, the Carron Company, the Coltness Iron Company Ltd., and Merry and Cunninghame Ltd., were engaged in machine mining. In 1912, coal cutters were in use at 97 of the 226 mines in Lanarkshire, thus, 42.9 percent of pits were mechanised.[103] The level of mechanisation in mines controlled by LCMA members was significantly higher than the county average. Indeed, of the 97 mines where cutters were used 59, or 60.8 percent were owned by association members. These statistics show a significant proportion of members of the LCMA to have a clear understanding of the benefits of modern mining techniques just like their counterparts in the eastern Scottish coal fields.

The table also shows that membership was skewed toward the larger mining concerns.[104] It was a phenomenon of the Lanarkshire coalfield that the larger mines were those most likely to adopt new technology.[105] This trait is also apparent in companies, which were only partially mechanised. James Nimmo and Company Ltd., for instance, practised machine mining at three of their six mines. Coal cutters were employed at Auchingeich - workforce of 885, Candlerigg - 530 miners, and Holytown - with 450 mineworkers. The number employed at the other three pits totalling just 433 workers.[106] Thus, it was the larger concerns, those with better access to investment capital which were most likely to be engaged in mechanised mining.

TABLE 2.2.3 LEVEL OF MECHANISATION, LCMA, 1912.

Company	No. Mines	Mechanised	Employees
R.Addie & Sons Ltd.,	6	3	2298
Wm Baird & Co., Ltd.,	5	3	2711
Wm Barr & Sons Ltd.,	2	2	1323
Baton Collieries Ltd.,	4	4	704
Bent Colliery Co., Ltd.,	2	2	1634
Carpington & Auchlochan Ltd.,	1	1	520
Carron & Co;	2	0	632
Chapel Colliery Co., Ltd.,	3	2	511
Coltness Iron Co., Ltd.,	6	0	1008
Darngavill Colliery Co., Ltd.,	7	5	1228
Jas Dunlop & Co., Ltd.,	6	2	1602
J.Dunn & Stephen Ltd.,	2	2	505
Farme Coal Co., Ltd.,	1	1	293
Flemington Coal Co., Ltd.,	1	1	586
Glasgow Coal Co., Ltd.,	3	3	1037
Haughhead Coal Co., Ltd.,	2	2	589
James Gemmell	1	1	249
Merry Cunninghame Ltd.,	2	0	1117
Jas Nimmo Co., Ltd.,	6	3	2298
Arch[Bd] Russell Ltd.,	6	6	3473
Summerlee Iron Co., Ltd.,	7	3	3096
United Collieries Ltd.,	16	8	4181
John Watson Ltd.,	6	3	2298
Wilson & Clyde Coal Co., Ltd.,	6	5	1945

Source; GUA, LCMA Minute Book UGD/159/1/8, List of Mines, 1912.

It is perhaps not surprising that the LCMA did not actively promote the diffusion of machine technology within the industry when cognizance is taken of the high level of competition that existed between coal producers. Nevertheless, the LCMA did avidly support member companies in disputes over their right to introduce new technology. The introduction of new technology in mining and the new work systems that this entailed led, in some instances, to conflict in the pits. For instance, the adoption of machine cutting often resulted in miners having to do their own drawing. That is, transporting the coal from the face to the main roads which led to the shaft bottom. As coal cutters were invariably used in the longwall system of mining the distances from coalfaces to main roads could be considerable. Time spent on this type of 'deadwork' frequently resulted in lower earnings as Scottish miners were generally paid in relation to the tonnage produced. Drawing disputes at James Gemmell's Hill Colliery and the Darngavil Coal Company's Birkrigg pit in early 1910 are examples of this phenomenon.[107] Such opposition was looked upon by the owners as a direct challenge to their right to manage and, consequently, they received the support of the LCMA in combating this threat. In this instance the dispute was settled by arbitration with the owners winning the '*right to manage*'.[108] A further example of conflict arising from the issue of mechanisation and management's right to manage was the case at Nimmo's Auchengray pit in 1914. Miners blocked a seam which was being worked by traditional hand-hewing methods because of a dispute over tonnage rates. Management subsequently introduced cutting machines into the seam, which caused an escalation in conflict. Despite the tonnage involved being somewhat trifling the LCMA supported Nimmo's in the ensuing dispute because they considered the issue to be of importance to other coal owners. Indeed, that the association was willing to impose a lockout is evidence of their resolve to ensure the right of member companies to modernise in the face of opposition from the mineworkers.

Conclusion.

To sum up, the survey of the two Fifeshire companies indicates that both these firms displayed a very positive outlook in relation to the adoption of modern mining methods. Due to a lack of primary material the conclusions reached for the Fife Coal Company Ltd., have had to be based predominantly on secondary sources. Nonetheless, the evidence shows this company to have been at the 'cutting-edge' of technological and organisational innovation in mining methods.

The Lochgelly Iron and Coal Company Ltd., also exhibited a very progressive outlook to the modernisation of their coal production techniques. The importance this concern attributed to the introduction of new technology and modern work systems was shown in their appointment of a works committee whose specific responsibility was the implementation of these new processes. To finance the modernisation of their coal production both these firms 'went public', thus, once more displaying signs of their progressive policies and attitudes to change within their industry.

The attitudes of Wm Baird and Company Ltd., to coal cutting by machine appear somewhat contradictory. From being pioneers in this field this concern subsequently appear to have abandoned machine cutting. One source has suggested this was due to labour opposition but little evidence has been found to corroborate this assertion. Despite the fact that Bairds had a much lower rate of diffusion of coal cutting machines than the Fifeshire companies this company did embark on an extensive modernisation programme at the beginning of this century. Unlike the other two companies, however, Bairds was not a public limited company, relying on its own directors for the means to finance its expansion.

The Lanarkshire Coal Masters' Association did not play an active part in encouraging the modernisation of its member companies. This, no doubt being due to the high level of competition that existed within the industry. The level of mechanisation of mines owned by members of the association indicates that it was the largest and most progressive firms who joined the LCMA. These companies had a disproportionately higher level of pits engaged in machine mining than the county average. The LCMA, although not an evangelising force for modernisation did, however, defend their members rights to introduce new techniques and working systems within the county, as the examples above have shown. The LCMA comprised the majority of the most progressive coal owners in the county and it provided these businessmen with an institutional framework which promoted modernisation through collective support.

III

Coal Production in the Inter-war Period.

As has been shown Britain, in 1913, was one of the major coal producers and the dominant coal trader on the international market. In that year the British coal industry produced 287.4 million tons, an amount never again equalled, which accounted for 23 percent of the world's total supply. Of this 96.7 million tons was exported, 21 million tons of this amount going to foreign bunkers. This tonnage represented 55 percent of all coal traded on international markets.[109] Comparable tonnage in 1939 were; total output 231.3 million tons (80 percent of the 1913 total), and 46.5 million tons in exports which represented just 48 percent of the pre-war total. The industry was subjected to various economic forces in these years but paramount amongst them, as the foregoing figures underline, was the collapse of the export sector. This factor is indicative of the stagnation of the international economy. It also highlights the rise in competition from other producers, other sources of energy, and the more efficient use of coal by industry as a whole. The slump in world consumption resulted in a decline in demand from Britain's staple industries, which led to reduced demand in the domestic market for much of these years. Not all coal producing areas in Britain were affected to the same degree. Telling regional variations existed and in some respects the experiences of the Scottish sector were less traumatic than those of many other districts.[110] However, a general overview of the factors that effected the economic structure of the British coal industry should prove instructive before concentrating more fully on the Scottish situation.

Coal production in the Twenties.

In the immediate aftermath of the Great War the industry benefited from buoyant markets, both domestic and foreign. The post-war boom stimulated domestic demand. It was, however, in the export field that market opportunities were greatest. There was an acute shortage of coal in 1919-1920, which was more, marked on the continent due to the disruption caused by the war.[111] This did not result in an increase in output, indeed, export output witnessed a slight decrease. The gains British producers made in these years took the form of a rapid rise in prices and profits. Export prices more than doubled and achieved their highest level in 1920, higher than in any other year between 1913 and 1930. Miners wages also rose dramatically in this short period. In 1920 they were more than 3 times their 1913 level.[112] Hours worked by miners were reduced. These two factors contributed to the low productivity that typified British mining in the period. The growth in profits led to an increase in staff levels which is reflected in the numbers employed. 1.2 million men were engaged in mining in 1920, the highest level in the industry's history. Arguably, the relative ease at which profits were made added to the long-term problems of coalmining because it encouraged an increase in labour at the expense of investment in more productive methods.

This era of high returns was followed by a sharp slump. Prices, profits and wages all declined rapidly. In 1922 prices were only one half of their 1920 level. The cut in wages and increase in hours worked following the deregulation of the industry resulted in a three month stoppage in late 1921. This stoppage and the longer one of 1926 further exacerbated Britain's position in overseas markets because it allowed her competitors to capitalise their market opportunities in the absence of British coal.[113]

The years 1923-24 saw another upturn in trade. This resulted, however, not from the increased competitiveness of British producers but from fortunate exogenous factors - a sixteen week coal strike in the United States and the French occupation of the Ruhr. The reduction in output from these two major coal producing areas provided British coalowners with easy access to various foreign markets. Nevertheless, the underlying downward trends in trade, which characterised British mining for most of the 1920s and much of the 1930s, reappeared midway through 1924. Falling prices, stagnant home markets and fierce foreign competition from that date served to highlight the problem of surplus capacity which was to dog the British coal industry in the inter-war period.

The main form of attack on the industry's problems adopted by British coalmasters was to cut costs. This was to be achieved through wage cuts, increased hours, and the 'laying off' of labour. This strategy was underlined in a speech delivered by Sir George Higgins C.B.E. at the annual meeting of William

France Fenwick & Company Ltd., in February 1925, when he stated that:,'he saw no solution to present difficulties unless British colliery working expenses were reduced and hours of labour increased so that they might come within a reasonable parity of conditions maintaining on the continent.'[114]

The severity of this assault led to the General Strike and subsequent mining lockout of 1926-7. Yet market conditions had deteriorated such that even with these significantly lower factor costs the industry still failed to make any headway in this period. During the twenties output had fallen by 6 percent and prices by 27 percent. Between 1913 and 1929 Britain's share of world output had decreased from 23.2 percent to 18.8 percent and her share in world trade was forced down to 45.3 percent.[115] It was only at the end of this decade, after the slight upturn of 1929 failed to materialise into a full-blown recovery, that coalmasters, and the government, recognised that the problems of this sector were not attributable to 'normal' economic fluctuations in trade but were those of secular stagnation and, as such, required to be tackled differently.

The world's coal producers faced competition from new forms of energy - oil and electricity and from technological advances in the use of coal, which further reduced demand on a global scale. For example, the amount of coal needed to produce one ton of pig-iron fell by 8 percent between 1913 and 1930 and by a further 12 percent in the years 1931 to 1936.[116] Even more dramatic inroads in coal utilisation efficiency were made in the electricity-generating sector. This fall in international demand increased the pressure on British producers. The protectionist barriers raised in response to the slump further reduced demand requirements.

Other factors outwith the control of British coalowners also had detrimental effects on British trade. The closing of the Russian market in the early 1920s and the inroads made by Polish producers into the Scandinavian markets, an area which had also made a large commitment to hydro-electric power generation, were particularly harmful to the Scottish exporting fields.[117] Other political action like the Dawes Plan which allowed Germany to pay her reparations in kind were harmful to the British producers. Although Germany made these payments with metallurgical coal which did not directly affect Britain, it could be argued that this act allowed the development of customer relations which was to prove detrimental to the British sector. This fact was recognised by many at the time including the executive of the MFGB.[118] Britain's return to the Gold Standard in 1925 with Sterling over-valued again added to the exporters problems. British coal was now less competitive, especially when the other major continental producers had undervalued currencies at this time.

Fierce price competition also saw British coalmasters at a great disadvantage. Between 1929 and 1936 British prices rose by 5.5 percent whereas Germany's fell by 22.4 percent. This was in great part a result of the lower productivity record of British producers as a investigation of output per manshift (0MS) reveals. In these years Britain's OMS increased by 8.4 percent. Those of her competitors rose as follows; Germany 34.5 percent, Belgium 38.1 percent, and the Polish producers in Upper Silesia by 52.9 percent. Innovations in underground organisation and structural changes were prominent features of the success of these countries. Little of these improvements in productivity can be attributed to an increase in mechanical cutting because, in the case of Germany for instance, 90 percent of her coal was cut by mechanical means in 1929.[119]

Some British coalowners, however, matched the enterprise of their foreign competitors. The Fife Coal Company, for example, sought to increase productivity through industrial reorganisation and increased mechanisation. In the years 1924 and 1925 this firm spent over £400,000 on reconstruction and expansion. It set up the Central Works and Stores Complex at Cowdenbeath. This resulted in cost savings by providing centralised control over operating staff, repair and maintenance, and purchasing. Such innovative reorganisation coupled with the closing of unproductive mines, such as, Blairenbathie, Lassode Mill, Cowdenbeath No 9 and Blairadam and this firm's commitment to machine mining ensured the Fife Coal Company emerged from the depression in a much stronger position than many of its rivals.[120]

Coal Regulation and Economic Upturn.

One of the major changes in the way the industry tackled its marketing difficulties in the 1930s were the schemes to control output and sales provided by Part I of the Coal Mines Act of 1930. By regulating output and setting minimum prices these cartelisation schemes were intended to stabilise markets and trade. However, they were implemented at district level and if any district set unrealistically low minima it led to increased inter-district competition, a feature it was supposed to eradicate. Proof of this failing in the scheme can be found in the Scottish sector where the exporting districts in the east were able to 'dump' their excess tonnage on the inland areas.[121] An amendment in 1935, which set separate quotas for inland and exporting districts, partly solved this anomaly. These quotas, however, were set according to existing patterns of distribution wherein the exporting regions had already established a market share in the inland districts.

A further disadvantage of this Act was that allocations to the various districts were fixed in a ratio to the total national tonnage. If the ratio was (say) 75 percent then each area could produce 75 percent of its standard tonnage irrespective of market demands. This resulted in some areas producing certain types of coal for which there was little or no demand.[122] Moreover, the setting of price minima coupled with guarantied sales did little to encourage efficient production methods. Indeed, the schemes protected inefficient producers and, thus, added to the industry's main problem - over capacity.

While British producers continued to suffer in international markets the industry did witness an upturn from 1934 onwards. This derived from a marked increase in demand in the domestic market, which can be linked, to the rearmament programme. Prices increased by 30 percent between 1934 and 1938 and because this was quicker than the increases in costs profit levels rose, reaching 98.5 percent of their 1920 level. Despite the increase in prices the export markets remained relatively stable due mainly to bi-lateral trade agreements.[123] Bi-lateral agreements with the Baltic countries proved particularly beneficial to Scottish exporters in the mid to late thirties. Table 2.3.1 highlights the pattern of Scottish coal exports in the 1930s.

Table 2.3.1 shows all areas increased trade to the Baltic Sea region during the period. This was especially true of the Western Scottish coal exports who were also the only group to increase exports to the North Sea area. Total output going overseas declined in all areas. However, the decrease in export levels in both of the Scottish divisions was less dramatic than for the country as a whole. That is, Britain's exports in 1937 were only 66.9 percent of her 1929 level, whereas those of the Eastern and Western Scottish coalfields were 83.1 percent and 71.3 percent, respectively. This in part resulted from the greater emphasis that Scottish coalowners put on bi-lateral trade agreements.

TABLE 2.3.1 SCOTTISH COAL EXPORTS, 1929-1937

	East Scotland		West Scotland		Great Britain	
Destination	1929	1937	1929	1937	1929	1937
Baltic Sea	31.4	68.3	5.1	18.6	11.1	25.3
North Sea	49.0	24.5	48.8	50.2	47.5	43.0
Mediterranean	13.8	3.5	33.2	18.9	26.7	17.6
Africa	0.1	0.3	0.0	1.1	2.0	2.0
N & C America	3.3	2.5	8.0	10.9	1.9	3.5
S America	1.8	0.9	4.6	0.1	9.0	8.1
Total Output (000s tons)*	4,829	4,014	1,835	1,309	60,267	40,338
% change from 1929		83.1		71.3		66.9

* Excludes amounts going to foreign bunkers.
Source: Calculated from data in Table 7.3 in B Supple, *The History of the British Coal Industry, Vol 4, 1913-1946*, Oxford, 1987, pp 292-293.

Industrial Structure and Employment.

Perhaps, one of the most damning criticisms of Britain's coal industry in this period was that it comprised of too many small undertakings, many of which were family controlled, run by people with conservative, cautious outlooks, who were only interested in short-term gains. This type of business structure had access to limited finance for investment in technological and organisational innovation and was controlled by people who lacked the will to promote the kind of change necessary to improve the industry's economic position. This criticism of the fragmented pattern of ownership of the industry has much validity. Indeed, table 2.3.2 reveals that, for Britain as a whole, the number of mines per firm in undertakings employing less than 5,000 workers was declining in the inter-war period. Companies with a labour force greater than 5,000 witnessed a slight increased in concentration in these years. Industrial concentration in

Scotland was approximately double the British average. The Scottish experience was the opposite of the country's as a whole. That is, the average number of mines per firm increased in undertakings employing 500 to 4,999 people. Whereas, the largest companies witnessed a fall in the number of mines per undertaking. However, Scottish undertakings employing more than 5,000 miners still averaged 50 percent more mines per company than was the case in the rest of Britain.

TABLE 2.3.2 INDUSTRIAL STRUCTURE, SCOTLAND AND BRITAIN, 1913-1938

(Average Number of Mines per Firm)

Size by Labour Force	Scotland			Great Britain		
	1913	1924	1938	1913	1924	1938
500-999	2.03	2.48	2.43	1.81	1.69	1.46
1000-2999	4.45	3.68	4.50	2.67	2.30	2.22
3000-4999	7.33	8.00	9.50	4.28	4.24	3.90
5000-	22.75	15.43	16.00	9.97	8.00	11.04

Source: B Supple, *'History'* 1987, table 9.4, pp 370-371.

There were, however, other institutional features which acted adversely against the concentration of units of production that were required if coalmining was to become efficient. If coalmasters did not own the surface land above the pits it was possible for it to be owned by several landlords whose agreement was needed for their successful merging and concentrating of mining operations underground. It was not until 1938, through the Coal Commission, that procedures were formulated to take mineral rights into public ownership. Thus, it was not until the end of the inter-war years that this possible constraint to reorganisation was removed.

The paying of royalties also increased costs. £6.4 million in royalties were paid to landowners in 1923 and 1924, which increased the price per ton of coal raised by 5¾d on average.[124] In 1925 a Mr Hardie argued in the House of Commons for the abolition of royalties on the nation's raw materials. The absence of this restriction on Britain's competitors was one reason, he contended, why they were able to produce steel cheaper.[125]

The threat and reality of government intervention was another factor that helped sustain the fragmented structure of coalmining. It has already been shown how Part I of the 1930 Act in certain instances prolonged the life of inefficient operations. Government subsidies in 1921 and 1925 also helped retain inefficient elements in the industry. The perceived threat of nationalisation may, in part, be responsible for the short-term outlook of some coal producers, 'There was a reluctance of coalowners to invest in long-term technical improvements because of the long standing uncertainty surrounding the future ownership of the industry'.[126]

Despite the level of criticism aimed at coalowners some structural reorganisation did occur during the inter-war period. In the years 1920-21 and 1923-24 several of the largest coal companies increased their holdings through mergers, examples of which include the Powell-Duffryn Steam Coal Company, Guest, Keen and Nettleford, Ebbw Vale Steel, Iron and Coal Company. In Scotland the Fife Coal Company Ltd., during 1923-24 acquired the Earl of Rosslyn's Collieries Ltd., and the Oakley Collieries Limited.[127] The majoritie of acquisitions at this time were financed with profits made in the war years and the post-war boom and were purchased to increase capacity and, it was hoped, profits. There was a further merger movement in the years 1926 to 1930. Still the majority of amalgamations at this time did not result in concentration of production in the most viable pits nor to inefficient producers in marginal pits being closed. In many instances the constituent companies retained their identity and management structures and, thus, little headway was made toward improving the competitiveness of the industry.

Part II of the Coal Mines Act of 1930 established the Coal Mines Reorganisation Commission to promote restructuring through merger. This body, however, met fierce opposition from coalowners. As this body lacked sufficient legal power to implement its proposals it made little impact on the situation. In the years between 1926 and 1930, 26 amalgamations had taken place, achieved through voluntary schemes established by the industry itself. These mergers involved 212,260 miners. In the period 1931 and 1936 there were 32 amalgamation schemes involving 164,500 workers. This represents a deceleration in mergers and Kirby argues that this resulted from the 'statutory cartel system' (established by Part I of the Coal Mines Act,) 'preserving the existing structure of the industry' which 'lessened the incentive to amalgamate.'[128] Nevertheless, it should be noted that the merger movement of the 1930s strove to reduce capacity by concentrating output in fewer pits and as such is evidence that the coalowners now recognised that structural change had to come if the industry was to survive.

As a counter to Kirby's argument the quota system introduced in Part I of the Act did help the industry along the path to concentrated production. Larger undertakings acquired some of the smaller, less efficient firms to get their standard tonnages. Thereafter, some marginal pits were closed. This, in part accounts for the decline in the overall number of British mines in these decades. In 1924, for example, there were 1411 firms operating 2507 mines. By 1938 these figures were 1034 and 1870, respectively.[129]

Furthermore, evidence from the Scottish sector indicates a movement towards concentration of production in a few large-scale companies. Firms employing more than 2,000 workers increased their share of the labour force from 18.3 percent in 1924 to 21.4 percent in 1938. These larger concerns were also increasing their share of output. In the late thirties four Scottish companies accounted for 35 percent of total output and in the Fife district the Fife Coal Company Ltd., and the Wemyss Coal Company respectively produced 41 percent and 27 percent of that county's output.[130] The Fife Coal Company, 'applied an exceptional degree of mechanisation and internal reorganisation to their more modern pits.'[131] Some of this reorganisation involved the closing of marginal pits. Indeed, between 1929 and 1939 this company reduced the number of its pits from 32 to 15 which resulted in labour being cut from 11,616 to 7,592.[132] Similar measures were under way at the Wilson and Clyde and Bairds and Dalmellington undertakings. Consequently, the move to a concentrated industry had started and this fact is reflected in the unemployment trends of these years.

The numbers employed in British coalmining peaked at 1,248,200 in 1920 and from that date witnessed a steady decline. By 1939 a total of 766,300 workers were employed in British mines. Of course significant regional variations existed but in general the exporting fields fared worse than inland districts as the following data reveal. In June 1927 the national average of coalminers wholly unemployed was 10.8 percent. In the main exporting areas of Northumberland, Durham, South Wales and Scotland the rates were 18.4 percent, 21 percent, 15 percent and 12.4 percent, respectively.[133] Scotland, it appears suffered less than the other exporting fields. Page-Arnot, however, shows that Scottish mining was contracting at a faster rate than the rest of Britain in these decades. Between 1923 and 1932 the Scottish mining workforce declined from 143,267 to 82,358. This represents a fall of more than one third whereas the English and Welsh mining industries reduced their labour power by just one quarter.[134]

Table 2.3.3 shows that all regions achieved peak employment levels in 1924. Scotland witnessed its lowest level of employment in 1933. English and Welsh mines experienced a steady decline in employment rates down to 1937. The figures confirm Page-Arnot's point that Scotland was shedding labour faster than mines in the rest of Britain until 1933. Thereafter, however, employment levels in Scotland increased steadily. By 1939, Scotland had a mining workforce equal to 72 percent of her 1922 total.

TABLE 2.3.3 MINERS EMPLOYED IN SCOTTISH REGIONS, ENGLAND AND WALES, AND GREAT BRITAIN, 1922-1938.

	Mid & East Lothian		Fife & Clackmn		Rest of Scotland	
	Miners (000s)	% Scot total	Miners (000s)	% Scot total	Miners (000s)	% Scot total
1922	13.9	11.3	26.7	21.6	82.6	67.0
1923	15.3	11.3	29.7	22.0	89.7	66.6
1924	15.9	11.2	30.9	21.9	94.5	66.9
1925	15.8	11.6	30.7	22.7	88.9	65.6
1926	15.3	12.1	28.5	22.5	82.4	65.3
1927	13.4	12.4	21.7	20.1	72.8	67.5
1928	12.7	12.4	22.9	22.4	66.9	65.2
1929	13.0	13.9	21.6	23.2	58.6	62.8
1930	13.5	13.3	23.8	23.5	63.8	63.1
1931	13.1	14.2	21.5	23.4	57.4	62.4
1932	12.9	15.0	20.5	23.8	52.6	61.1
1933	12.3	15.1	18.7	23.0	50.3	61.8
1934	12.4	14.8	20.4	24.4	50.6	60.7
1935	12.5	15.1	20.6	24.9	49.5	59.9
1936	12.4	14.8	21.4	25.4	50.2	59.7
1937	12.6	14.5	22.4	25.8	51.7	59.6
1938	13.2	14.4	23.5	25.7	54.6	59.8
1939	13.1	14.7	23.0	25.8	53.1	59.5

	Scotland		England & Wales		Great Britain
	Miners (000s)	% G.B. total	Miners (000s)	% G.B. total	Miners (000s)
1922	123.2	11.6	940.7	88.4	1063.9
1923	134.6	11.8	999.8	88.1	1134.4
1924	141.4	11.9	1044.5	88.0	1185.9
1925	135.4	11.9	1003.6	88.1	1139.0
1926	126.2	11.5	973.4	88.5	1099.6
1927	107.9	10.8	888.2	89.2	996.1
1928	102.6	10.5	868.9	89.4	971.5
1929	93.3	10.3	813.7	89.7	907.0
1930	101.0	10.6	853.8	89.4	954.8
1931	92.0	10.4	790.2	89.6	882.2
1932	86.1	10.2	753.6	89.7	839.7
1933	81.4	10.4	703.1	89.6	784.5
1934	83.3	10.6	702.3	89.4	785.6
1935	82.7	10.7	688.4	89.3	771.1
1936	84.2	11.1	675.5	88.9	759.7
1937	86.7	11.4	673.8	88.6	760.5
1938	91.2	11.5	699.3	88.5	790.5
1939	89.2	11.5	684.9	88.5	774.1

Source: Ministry of Labour Gazette, 1922-1939.

There were regional differences. For example, Fife and Clackmannan and the Lothian districts increased their share of miners by 4.12 percent and 3.36 percent, respectively. Indeed, in the Lothians area the number of miners employed in 1939 was just 6 percent below the 1922 figure. That Scottish coal producers were able to emerge from the depression some four years earlier than their southern competitors is evident from the above figures. But what lay behind this phenomenon? It would not be unreasonable to assume that the innovative organisational changes and the high level of commitment to modern mining methods played a significant part in their success.

Lythe and Butt suggest part of the problem in Scotland's case stemmed from the regions high use of mechanised cutting and conveying methods. By 1937, according to these commentators, 79 percent of Scottish coal was cut by machine and 57 percent conveyed by mechanical means. The output in 1936 was roughly that of 1913, whereas employment had declined by approximately 20 percent.[135] Thus, it seems that technological unemployment was a factor in the reduction of Scottish mineworkers in the inter-war period. This theme receives detailed analysis in chapter 3.

Mechanisation in Scottish Pits, a Regional Comparison.

Tables 2.3.5 to 2.3.10 in the appendix show the level of mechanisation in the various Scottish coal producing areas during the inter-war period. Perusal of these regional statistics reveals a variance in the diffusion of mechanised mining. Fife, Clackmannan, Kinross and Sutherland was the most technically advanced area. Indeed, by 1938, as can be seen from table 2.3.5, 86 percent of mines used coal cutters, 90 percent of output was got by machine and 84 percent of total output was transported by conveyors. The unabated rise in the amount cut and transported by machine technology is clearly evident, as the growth in the number of electric coal-cutters and face conveyors used in this county testifies. For example, the number of electric coal cutters increased from 251 to 343 over the period, a rise of 37 percent. This near continuous increase was interrupted twice, during the strike and lockout of 1926-7 and at the height of the depression, 1931-33. Throughout the inter-war years the increase in the use of face conveyors was unrelenting, rising from 25 to 272. Cognizance of these facts underlines the commitment of coal producers in Fife to the modernisation of their industry.

Mid and East Lothians was another district which witnessed a sustained rise in the level of mechanisation within its mines. As can be seen from table 2.3.6 the percentage of mines using machines grew from 45 to 76. The largest increased took place between 1934-5 which demonstrates the measures adopted by Lothian coal masters to meet the demand of the economic upturn of the mid-thirties. That is, producers in this region strove to meet the increased demand for coal through greater use of modern mining methods. The number of electric cutting machines in use rose from 60 to 168. The adoption of face conveyors, however, was much slower than in neighbouring Fife, increasing from 25 to 62. In 1938, 62 percent of coal was produced mechanically and 65 percent was transported by conveyor. The amount of coal cut by machine witnessed a sustained rise as just 21 percent of coal was extracted by such means in 1921, despite the fact that 45 percent of mines used cutters at that date.

The Ayrshire coal field, table 2.3.8, experienced the fastest rate of growth in mechansied coal production in a relevant sense. At the earlier date 21 percent of mines used cutters and produced 16 percent of the county's total output. In 1921 only 4 face conveyors were in use in Ayrshire. During this era the ratio of mines producing coal by mechanical means increased from one fifth to two thirds, and the proportion of machine-cut coal increased by more than fourfold. Indeed, by 1938, 64 percent of mines employed cutters, (the number of electric cutters rising from 58 to 230). 69 percent of output was mechanically cut and 39 percent transported by conveyor, the number of face conveyors in use in 1938 having risen to 97. Mechanised coal production in Ayrshire had undergone a remarkable transformation making substantial inroads in the lead held by producers in the east of Scotland.

The Lanarkshire area, on the other hand, was the only area in the Scottish coal industry, which experienced a decline in the quota of mines using coal cutters.

Table 2.3.7 indicates that the ratio of such mines decreased from 51 percent in 1921 to 46 percent in 1938. In keeping with this the number of electric cutters employed in the region fell from 833 to 781. However, this district did see a substantial rise in the number of face conveyors, which increased from 37 to 352. Indeed, in 1938, Lanarkshire accounted for 41 percent of face conveyors used in Scotland. Although this region recorded a threefold increase in the percentage of tonnage conveyed by machine during the period this was still 8 percent below the British average and 12 percent less than the Scottish average. However, it should also be noted that the percentage cut by machine almost doubled during this era from 45 percent to 84 percent. This indicates that the expansion of mechanised cutting in this county was taking place in pits, which had already embraced modern mining techniques. Thus, the diffusion of new technology in this county was intensive in nature rather than extensive.

Comparing the positions of Scotland and England and Wales, tables 2.3.9 and 2.3.10 the figures show English and Welsh mines to have narrowed the gap in terms of the percentage of mines using machinery. In 1919, 26 percent of British mines employed mechanical cutters. This had increased to 44 percent by 1938. The ratio of Scottish mines using cutting machines also grew in this era, however, the increase was relatively modest rising from 48 to 56 percent. The Scottish data undoubtedly reflects the decline in mechanised mines in Lanarkshire. Furthermore, when the type of cutting machine is considered it is clear that English and Welsh coal masters were switching to the more efficient electric coal cutters. Indeed, the number of such machines had increased more than fourfold, from 893 to 3584.[136] Yet, it is interesting to note that while the use of compressed-air cutters in Scottish pits had all but vanished by 1938, they still formed an important and growing part of mechanised coal production south of the border.

Scotland, however, still maintained her lead in terms of tonnage cut by machine, 80 percent compared with 59 percent in the rest of Britain. The use of face conveyors became more commonplace in British coal mining throughout these years. Mines in England and Wales witnessed an increase in the use of this innovation by just under 700 percent. While Scottish pits recorded a rise of nearly 800 percent. The growth in face conveyors was reasonably constant in English and Welsh mines between the wars, the only significant increase occurring in the troubled years of 1926-7, when the adoption of these conveyors grew by 27 percent. Scotland witnessed a similar growth in the use of face conveyors in 1926-7. In the Scottish case, however, the increase was 54 percent, double the English and Welsh figure. Long makes reference to this phenomena arguing that it was primarily a labour-shedding exercise.[137] The difference in magnitude in the increase in conveyors between the two areas reflects the higher level of mechanisation in Scotland and the powerful position Scottish coal masters held owing to the weakness of Scottish mining unions at that time.[138] With regard to the the percentage of output conveyed under ground, English and Welsh coal producers made significant strides forward in this era showing a growth of more than 400 percent. The Scottish experience was also one of growth, more than doubling the volume of coal transported by conveyor from 25 to 58 percent. Although Scottish producers maintained their lead in the level of mechanisation in mining operations English and Welsh coal owners were fast closing the gap at the end of this period of study.

It has been argued that the existence of poor industrial relations had an influence on the willingness of owners to invest in new techniques, and hence on the level of mechanisation. A frequent reply by owners to both government and public criticism of their failure to modernise was that of labour opposition to change. The Reid Report, as noted in the previous chapter, seems to substantiate this charge. While evidence exists that organised labour was violently opposed to amalgamations in the 1930s owing to the effects that mergers had on employment there appears to be little evidence suggesting trade unions were against machine mining *per se.*[139] The level of mechanisation outlined in tables 2.3.5 to 2.3.10 and the high degree and distribution of electricity in Scottish pits as shown in table 2.3.4 indicates that Scottish labour was not as obstructive as Reid's comment suggests.

Table 2.3.4 portrays the degree and distribution of electricity in Scottish and English and Welsh mines between 1919 and 1938. The first point of interest is that coalowners in England and Wales increased the ratio of mines using electricity from 49 percent to 67 percent during the period, reflecting the diffusion of electrically powered cutting machines noted earlier. In so doing southern producers had made significant progress in catching up with Scottish coalowners who maintained a constant level of electricity used in mines at 70 percent. Secondly, and perhaps more importantly, it should be noted that in Scottish mines nearly 80 percent of electrical power was utilised below ground which was double the English and Welsh figure. This, as well as, reflecting the higher degree of mechanisation in Scottish mines also highlights the preference of Scottish owners for the more advanced electrically powered cutters over those driven by compressed air as can be seen from tables 2.3.5 to 2.3.10.

Scottish mines also favoured electrically powered conveyors to a greater extent than southern pits. Indeed, in mines in the Ayrshire and Lothians regions all conveyors are recorded as being driven by electricity and only two conveyors powered by compressed air are noted as being in use in the Fife area.[140] The greater use of electricity underground is also an indication that Scottish producers were committed to organisational changes below ground and, thus, were adopting innovative methods similar to those of their foreign competitors. Change in underground organisation has been acknowledged as one of the primary factors, which underpinned the enhanced productivity of foreign producers. Therefore, it can be argued that a significant section of Scottish coal owners exhibited positive attitudes to the modernisation of their industry, which is demonstrated by the high level of mechanisation in Scottish coal mines.

TABLE 2.3.4 LEVEL AND DISTRIBUTION OF ELECTRICITY IN SCOTTISH AND ENGLISH AND WELSH MINES, 1919-1938.

	Mines using Electricity	% of Area (000s)	H.Power U/Ground (000s)	H.Power Surface (000s)	H.Power Total
			Scotland		
1919	356	70	157.1	42.2	199.4
1920	352	68	166.1	43.1	209.2
1921	372	70	171.5	45.8	217.3
1922	359	70	179.3	50.0	229.4
1923	366	71	202.5	56.0	258.5
1924	368	72	213.0	61.2	274.2
1925	351	70	221.2	63.6	284.8
1926	343	66	216.8	64.6	281.4
1927	319	63	218.5	66.8	285.3
1928	311	70	222.9	68.9	291.8
1929	315	71	230.3	70.4	300.7
1930	308	75	241.5	73.2	314.7
1931	294	72	235.6	71.9	307.5
1932	273	72	225.4	71.2	296.7
1933	263	72	228.6	72.4	301.0
1934	259	70	235.5	73.4	308.8
1935	258	71	245.5	75.1	320.6
1936	272	70	261.2	80.8	342.0
1937	285	70	272.3	87.1	359.4
1938	295	69	279.3	90.2	369.5
			England and Wales		
1919	*	*	430.2	399.4	829.6
1920	1152	49	452.7	418.9	871.6
1921	1198	48	473.4	457.4	930.8
1922	1198	50	508.7	502.1	1010.8
1923	1223	51	550.6	555.6	1116.2
1924	1262	54	597.7	609.8	1207.5
1925	1238	56	619.2	652.2	1271.4
1926	1234	53	635.2	703.5	1338.7
1927	1209	51	659.8	739.1	1398.9
1928	1156	55	674.7	755.8	1430.5
1929	1141	58	687.8	765.1	1452.9
1930	1131	59	720.4	788.5	1508.9
1931	1115	60	725.3	800.7	1526.0
1932	1086	61	744.7	813.9	1558.6
1933	1073	61	755.7	831.8	1587.5
1934	1069	61	786.6	853.7	1640.3
1935	1066	62	811.6	878.2	1689.8
1936	1060	62	897.5	897.5	1795.0
1937	1073	63	879.4	923.3	1802.7
1938	1130	67	918.9	955.5	1874.4

* Figures not available.
Source: Annual Reports of His Majesty's Chief Inspector of Mines, 1919-1920, Annual Reports of the Secretary of Mines, 1921-38.

Conclusion.

It has been shown that various factors influenced the economic position of the British coalmining industry between the wars. In some respects it appears that the Scottish sector differed in many ways from the general picture outlined above. For instance, some of the exporting companies in the Fife district seem to have adopted the technical and organisational innovations cited by many observers as essential for economic survival. Coal companies in south west Scotland, Bairds and Dalmellington, for example, also displayed progressive attitudes in this period. Although export markets declined by 16 percent for east coast producers and 29 percent for western coal exporters this was less than the overall decline in British exports in the thirties which decreased by 33 percent. Scotland had, on average, double the number of mines per firm than the British norm. Scottish coalowners also led the way in mechanised production methods, in both the number of coal cutters and conveyors and the level of use of electricity as a power source. This evidence and the speed at which Scottish producers emerged from the depression suggests that companies like the Fife Coal Company and Bairds and Dalmellington, far from being unique examples, were, perhaps, closer to the Scottish norm.

[1]See table 2.1.17 in the appendix.
[2] N K Buxton, *The Economic Development of the British Coal Industry*, (1978), pp 99 & 100. These export totals also include the tonnage shipped for foreign bunkers.
[3]Ibid, p 91.
[4]Ibid, table 2, p 87.
[5]*Colliery Guardian*, Vol, LXIV, 9 December, 1892, p 1075.
[6]*Colliery Guardian*, Vol, LXV, 10 March, 1893, p 458.
[7]*Colliery Guardian*, Vol LXXXI, 26 April, 1901, p 908.
[8]A.Muir, *The Fife Coal Company Limited; A Short History*, (Cambridge, 1954), p 13.
[9]*Colliery Guardian*, Vol, XCI, 5 January, 1906, p 25, and Vol, XCIX, 14 January, 1910, p 71.
[10]Ibid, Vol, LXIX, 4 April, 1895, p 708.
[11]Ibid, Vol, CV, 10 January, 1913, pp 72-74.
[12]Ibid, Vol, LXXXV, 9 January, 1903, pp 84-85.
[13]Ibid, Vol, LX, 15 August, 1890, p 252. In a speech delivered to the Northern Union of Mechanics Institute.
[14]Ibid, Vol, XCI, 5 January, 1906, p 25.
[15]Ibid, Vol, LXXXIII, 7 February, 1902, p 254 and 28 February, p 464.
[16]Ibid, Vol, LXXXIX, 24 March, 1905 p 499.
[17]Ibid, Vol, LXIV, 2 December, 1892, p 1017, and Vol, LXV, 1893, 7 April, p 632.
[18]See Tables 2.1.7 to 2.1.17, in the appendix.
[19]A J Taylor, 'Labour Productivity and Technical Innovation in the British Coal Industry, 1850-1914', *Economic History Review,(EHR)*, Vol XIV, No. 1, (1961), p 51.
[20]*Colliery Guardian*, Vol, LXVIII, 26 September, 1894, p 569. Producers in Fife and Clackmannan lost shipments totalling half a million tons, mostly to English coal masters. The invasion of Scottish domestic markets by English merchants was a very unusual event due to the price advantage derived from the lower wage economy in Scottish mining and the keen inter-district competition north of the border which was usually sufficient to keep southern coal out.
[21]*Colliery Guardian*, Vol LXXII, 3 July, 1896, p 25.
[22]See table 2.1.5, p 59.???
[23]*Royal Commission on Coal Supplies*, Part III, (B.P.P.) (Scotland), 1905, (Cd 2359), Report by J.S.Dixon on available coal resources of District F p 9. Dixon shows near static growth in output from Lanarkshire between 1892 and 1902. Due, in his estimation, to the increasing exhaustion of thicker seams.
[24]All statistics calculated from data in tables 2.1.7 to 2.1.17 in the appendix.
[25]J Benson, *British Coalminers in the Nineteenth Century, A Social History*, (1989), p 7. Also see Buxton, *Economic Development*. p 119, and M W Kirby, *British Coalmining Industry, 1870-1946*, (1977), p 7.
[26]Kirby, *British Coal*, p 7.
[27]Buxton, *Economic Development*, p 113.

[28]"Ca'canny" was when miners withheld their labour by restricting the shifts worked in an attempt to regulate supply and demand, thus, raising prices and wages.
[29]Sir R A S Redmayne, *The Problems of the Coal Mines*, (1945), p 36. Redmayne notes that accurate figures which would enable such calculations only became available in the later inter-war period.
[30] Also see table 2.1.18 in the appendix
[31]Taylor, *(EHR)*, Vol XIV, No. 1, (1961), p 54.
[32]*Colliery Guardian*, Vol LXXXV, 17 April, 1903, p 848.
[33]Kirby, *British Coal*, p 6.
[34]See table 1.1, p 21.
[35]*Colliery Guardian*, Vol LXXXIX, 28 April, 1905, pp 692/3.
[36]Buxton, *Economic Development*, p 87, table 2. Buxton shows the iron and steel sector as the second largest market for coal in 1887, general manufacturing creating the biggest demand taking 26% of coal to iron and steel's 16.5% and exports with 15%.
[37]*Colliery Guardian*, Vol LXI, 12 June, 1891, p 1005.
[38]Ibid, Vol LXII, 18 September, 1891, p 485.
[39]Ibid, Vol LXVII, 12 January, 1894, p 63.
[40]Ibid, Vol LXVIII 10 August, 1894, p 255.
[41]Ibid, Vol LXX, 22 November, 1895, p 980.
[42]Ibid, Vol LXXVII 6 January, 1899, p 15.
[43]Ibid, Vol LXXXIX 13 January, 1905, pp 70-71. It should be noted, however that exports to France at this time were facing stiff competition from German producers.
[44]Ibid, Vol LXIII 29 January, 1892, p 206.
[45]A Slaven, *The Development of the West of Scotland, 1750-1960,* (1978), p 169. Slaven comments on the number of small, one concern companies in the western coalfields in this period.
[46]Benson, *British Coalminers*, pp 23-25.
[47]R Church, *The History of the British Coal Industry, Vol 3, 1830-1913: Victorian Pre-eminence*, (Oxford, 1986), pp 400 & 401.
[48]A more detailed account of this expansion is conducted below, pp 64,65.
[49]B Lenman, *An Economic History of Scotland, 1660-1976*, (1977), p 182. Lenman comments upon the progressive marketing policy of the management and that the company was also technologically progressive.
[50]Church, *History*, p 147.
[51]Benson, *British Coalminers,* p 25.
[52]Church, *History*, table 5.3, p 400.
[53]List of Mines, 1914.
[54]I Church, *History* table 2.10, p 140.
[55]Ibid, pp 145-146.
[56]Ibid, *History*, p 364.
[57]*Colliery Guardian*, Vol LXXII, 4 December, 1896, p 1078. Presented in a paper given at the Midlands Institute of Mining. Clarke's figures also show electric machines to be cheaper.
[58]Buxton, *Economic Development*, p 113.

[59]See chapter 1, pp 20-22.
[60]Figures from Table 2.1.12, in the appendix.
[61]A.Muir, *The Fife Coal Company Limited: A Short History*, (Cambridge, 1954), pp 4 & 8.
[62]It should be noted that data on the recording of mines using coal cutters is only possible for mines in the eastern Scottish division - this information was not recorded by the Mines Inspector for the western district. This information is available from 1910 onwards when the two Scottish districts were amalgamated.
[63]List of Mines, 1914.
[64]Muir, *Fife Coal Company*, p 11.
[65]Ibid, p 124.
[66]B Lenman, *An Economic History of Scotland, 1660-1976*, (1977), p 182. Lenman comments upon the progressive marketing policy of the management and that the company was also technologically progressive.
[67]R Church, *History*, p 147.
[68]Muir, *Fife Coal Company*, pp 13 & 20.
[69]Church, *History*, table 5.3, p 400.
[70]Scottish Record Office, [SRO], Lochgelly Iron and Coal Company Ltd., [LICC] Minute Book 1891-1905, Directors' Meeting 26 February, 1892, CB.2/203, p 48,
[71]SRO, LICC, Minute Book 1891-1905, Directors' Meeting 4 October, 1901, CB.2/203, p 370.
[72]SRO, LICC, Minute Book 1891-1905, Directors' Meetings 22 October, 1902, 6 March, 1903, and 8 May, 1903, CB.2/203, pp 428, 437, and 445.
[73]SRO, LICC, Minute Book 1891-1905, Directors' Meeting 2 November, 1894, CB.2/203, p 153.
[74]List of Mines, 1912.
[75]SRO, LICC, Minute Book 1891-1905, Directors' Meeting 15 February, 1905, CB.2/203, p 536, .
[76]SRO, LICC, Minute Book 1891-1905 & 1906, CB.2/203 & 204 and Agenda Books 1905-08, 1908-12, 1912-15, CB.2/198, 199, 200, Directors' Meetings various dates 1905-1912.
[77]SRO, LICC, Minute Book 1906, CB.2/204, 26 September, 1906, and 21 November, 1906, pp 44 and 55, and Agenda Book 1905-1908, CB.2/198, 4 September, 1907, and 20 December, 1907.
[78]SRO, LICC, Minute Book 1906, CB.2/204, Directors' Meeting, 31 January, 1906, p 4.
[79]J L Carvil, *Fifty Years of Machine Mining Progress*, (Motherwell, 1949), p 34.
[80]SRO, LICC, Agenda Book 1905-1908, Directors' Meeting, 16 Octrober, 1907, CB.2/198.
[81]SRO, LICC, Agenda Book 1908-1912, Directors' Meeting, 8 September, 1909, CB.2/199.
[82]SRO, LICC, Minute Book 1891-1905, Directors' Meeting, 17 July, 1902, CB.2/203, p 421.
[83]SRO, LICC, Minute Book 1891-1905, Directors' Meeting, 4 March, 1904, CB.2/203, pp 487-489.

[84]SRO, LICC, Minute Book 1891-1905, Directors' Meeting, CB.2/203, 15 May, 1896, and 27 November, 1896, pp 206-208 and 225.
[85]SRO, LICC, Minute Book 1891-1905, Directors' Meeting, CB.2/203, 6 November, 1901, p 376.
[86]SRO, LICC, Minute Book 1891-1905, Directors' Meeting, CB.2/203, 9 August, 1905, p 567.
[87]Church, *History*, pp 145-146.
[88]R D Corrins, 'William Baird and Company: Coal and Iron Masters 1830-1914', University of Strathclyde PhD. thesis, 1974, pp 234-237.
[89]Ibid, p 237.
[90]Ibid, p 240. The source quoted to substantiate this assertion was an article in the *Colliery Guardian* dated 28 May 1901. The *Colliery Guardian* was not published on that particular date. However, it was noted in an article of 22 February, 1901, 'that machine cutting had been stopped principally on account of the opposition of the men in various ways, combined with the fact that local conditions made it inadvisable to run any risk of trouble on that score'. The reference to various forms of opposition and local condition suggest that potential labour unrest could be the result of grievances not necessarily directly caused by the use of machine cutters.
[91]Ibid, p 241.
[92]Glasgow University Archives, [GUA], William Baird and Company Ltd., Valuation Books, 2 & 3, UGD/164/2/5/1 & 2.
[93]GUA, William Baird and Company Ltd., Valuation Books,4-7, UGD/164/2/5/3-6.
[94]List of Mines, 1912 & 1914.
[95]Strathclyde University Archives, [SUA], Inventory Book, Gartsherrie, 1925-1933, pp 751-754.
[96]GUA, William Baird and Company Ltd., Agenda Book, 1893-1920, UGD/164/1/1.
[97]Ibid, 9 August, 1905.
[98]Ibid, 4 December, 1907.
[99]Ibid, 14 June, 1914.
[100]GUA, William Baird and Company Ltd., notes on Capital Expenditure, UGD/164/1/2/9.
[101]Corrins, thesis, pp 229-230.
[102]Ibid, p 218.
[103]List of Mines, 1912.
[104]The average size of mine in Lanarkshire in 1912 was 256 employees, that is, total workforce,(57900), divided by total number of mines, (226) equals a county average of 256 employees. Only three out of the total LCMA member firms engaged in mechanised mining, the Darngavil Colliery Company Ltd., and Baton Collieries Ltd., and the Chapel Coal Company Ltd., employed less than the county average.
[105]This was also true of most coal fields in Scotland. For example see the data on the Ayrshire coal field in chapter 5, pp 242-3.
[106]List of Mines, 1912.
[107]GUA, LCMA, Minutes, 8 April, 1910, UGD/159/1/7.

[108]GUA, LCMA, Minutes, 31 August, 1910, UGD/159/1/7.
[109]B Supple, *The History of the British Coalmining Industry, Vol 4, 1913-1946*, (Oxford, 1987), Figures calculated from data in table 1.1, pp 8 & 9.
[110]R H Campbell, *Scotland Since 1707: The Rise of an Industrial Society*, (Oxford, 1971), p 256.
[111]Lenman, *Modern Scotland*, 1977, p 218.
[112]Supple, *History*, tables 5.1a and 5.1b, pp 174-7.
[113]R H Campbell, *Scotland Since 1707*, p 255.
[114]*Colliery Guardian*, Vol CXXIX, 27 February, 1925, p 512.
[115]Supple, *History*, p 173.
[116]Supple, *History*, p 253.
[117]S G E Lythe & J Butt, *An Economic History of Scotland, 1100-1939*, (Glasgow, 1975), p 220.
[118]*Colliery Guardian*, Vol CXXIX, 13 February, 1925, p 408.
[119]Supple, *History*, pp 284-287.
[120]Muir, *Fife Coal Company*, pp 38-41, 50-56.
[121]Ibid, p 298, and Kirby, 'Control of Competition in the British Coalmining Industry in the Thirties' *Economic History* Review,*(EHR)*, Vol XXVI, (2), (1973), p 275.
[122]Kirby, *EHR*, Vol XXVI, (2), (1973), p 278.
[123]R H Campbell, *Scotland Since 1707*, p 255.
[124]*Colliery Guardian*, Vol CXXX, 10 July, 1925, p 89.
[125]*Colliery Guardian*, Vol CXXIX, 13 March, 1925, p 643.
[126]Kirby, *British Coal*, p 190.
[127]Muir, *The Fife Coal Company*, Appendix VI. p 125,
[128]Kirby, *EHR*, Vol XXVI, (2), (1973), p 282.
[129]Supple, *History*, p 302.
[130]Ibid, pp 368 and 306n.
[131]Ibid, p 185
[132]Ibid, p 311, & p 311n.
[133]Ibid, p 260n.
[134]R Page-Arnot, *A History of the Scottish Miners*, (1955), pp 203-204.
[135]Lythe and Butt, *Economic*, p 221.
[136]English and Welsh figures calculated by subtracting the Scottish figure from the British total.
[137]P B Long , 'The Economic and Social History of the Scottish Coal Industry, 1925-1939, with Particular Reference to Industrial Relations', University of Strathclyde PhD thesis, 1978, p 130.
[138]The issue of unemployment and the diffusion of conveyors in Scottish pits is analysed in more depth in chapter 3, in the section titled, The Effect of New Technology on Employment, pp 135-145.
[139]Kirby, *EHR*, Vol XXVI, (2), (1973), pp 281-2
[140]Annual Reports of the Secretary for Mines, 1928-1938.

CHAPTER 3

Work in Scottish Coal Mines

The introduction of new technology into mining had profound and far-reaching effects for work and workers in the Scottish coalfields. Several commentators have argued that the introduction of new technology into industry has resulted in intensification of the work process, loss of control in the workplace, the deskilling of labour, and unemployment. For example, I Benson and J Lloyd argue that the introduction of advanced technology and new work methods led to radical changes in the pattern of employment in industry. In effect they contend that new technology leads to the deskilling of craft workers and their subsequent downgrading to machine minders and unskilled labourers.[1] These authors further emphasise the labour-saving aspect of mechanised production methods. Indeed, they note that the term unemployed first became common in the later decades of the nineteenth century, an era which also saw the mass production of machines.[2] J Gennard and S Dunn, in their work on the British printing industry also contend that technological change resulted in a decline in skilled personnel. Gennard and Dunn argue that this deskilling process is accompanied by a loss of control in the workplace.[3] Loss of workers' control at the point of production, Braverman argues, is the result of the potential of technology to separate the tasks of conception and execution or mental labour and manual labour. In adopting this strategy management is able to gain control at the point of production.[4] Technological change as well as leading to loss of control and the down-grading of labour also increases the burden on workers because of its tendency to intensify the work process:

> previously top managers had to rely on workers' handicraft skills for guidance as to the best methods for carrying out particular tasks. Now machines are used as the basis around which work tasks are organised. Machines pace workers and define their particular tasks.[5]

These various theories will now be analysed and tested in the context of the Scottish mining industry during the 1890-1939 period. This first section will consider whither coal cutting and conveying machinery led to intensification of work in the pits.

Mechanisation and Intensification of Work in Scottish Mines.

The growing move to mechanised production techniques in Scottish pits had a significant impact on the intensification of work processes for workers in the industry. That is, the physical burden and tempo of work increased due to the pacing effect of machinery and the extra effort that new work systems demanded. If maximum efficiency was to be achieved following the introduction of new technology to underground operations then new work systems, which were compatible to mechanised coal extraction, had to be introduced. D Greasley, in his work on the diffusion of machine coal-cutters in British mines has highlighted the need for revolutionary changes to mining practices. He states:

> Machine-mining required the introduction of 'factory-type' production at the coal face. Unspecialized, small-scale and largely unsupervised working had to be replaced by a system characterised by a high division of labour, concentrated workings and close supervision.[6]

Traditional mining practice saw miners using hand tools working the coal in small groups and exercising a considerable degree of autonomy in the workplace with regards to how the work should be carried out and the number of hours or length of shift required to do the work. This was not suited to modern mining methods. Machine mining required strict adherence to pre-arranged, systematic work schedules. This invariably necessitated a switch to a three-shift system of working which meant more supervisors underground and much closer supervision of all operations in the pit. In other words a cycle system of working had to be introduced. For the system to succeed each shift had to complete its allotted tasks on schedule. Failure to complete the shift on time resulted in succeeding shifts being held up and thus production targets were not met. An article in the *Colliery Guardian* in 1929 emphasises this point:

> Intensive mining necessitates the rigid adherence to pre-determined time-tables, and unless any specific work to be performed is completed in the time allotted to it, the work following it is held up, and the system breaks down. This can only be overcome by most careful supervision, and by arranging that the work to be done is well within the capability of the men chosen to perform it, otherwise the loss entailed by not having the work completed in time is far greater than the cost of any extra labour that may be required to complete it.[7]

Machine coal cutting equipment, especially in the early years of this investigation, was particularly prone to mechanical or electrical failure. When such stoppages occurred machinemen and their assistants would be encouraged, and in many instances coerced into working over their recognised shift. Many examples of mineworkers having to work longer hours due to the problems associated with mechanical failure of cutting machines exist in the available source material, especially in the records of the mining unions. The Lanarkshire Miners' County Union, for instance, devoted a significant amount of time to this issue in the years prior to the Great War. At the Brounieside pit in 1906 several machinemen were noted as having been dismissed for refusing to work over the eight hour shift.[8] Four years later seven miners suffered a similar fate at the Broomfield mine.[9] The extent of overtime that machinemen worked could be considerable. The LMCU records show that some miners were working 12 to 16 hours continuously at Archibald Russell's Greenfield pit in 1913.[10]

After the miners' defeat in 1926-7 (in the General Strike and the succeeding lockout) and in the depression years in the early thirties colliery managements throughout the Scottish coalfields used their new position of authority to accelerate the mechanisation process in the pits and also imposed longer hours of work. The weakened position of organised labour within the industry and the prevailing economic climate meant mineworkers could pose little opposition to this concerted attack on their conditions of work. Mineworkers were often coerced, threatened with unemployment, to work on past their normal shift. Andrew Clarke, formerly the president of the Mid and East Lothian Miners' Association (MELMA) and, in 1933 president of the National Union of Scottish Mine Workers (NUSMW) highlighted the plight of workers in the industry regarding this issue:

> Large numbers [of miners] are faced with the alternative of dismissal from their employment if they refuse to continue at work after their regular shift is up. The result is that frequently men are being compelled to work eight and even nine shifts in a week, while scores of men at these same collieries are unemployed and unable to obtain even a single day's work occasionally.[11]

References to long working hours are replete in the LMCU's records following the implementation of the Eight Hour Act in 1909. The reduction of one hour in the hitherto normal shift saw a general speed-up in work in the pits as mine owners throughout the industry strived to produce similar output in eight hours as they had previously in nine hours. An integral part of the speed-up process involved greater and more intensive use of mechanical cutting equipment. However, friction over this issue pre-dates the Eight Hour Act. In the Fifeshire coalfield problems over long hours and coal cutting machines are to be found earlier in the century. The minutes of the Fife and Kinross Miners' Association (FKMA), highlight that trouble was brewing at the Hill o' Beath mine in the spring of 1904. The following resolution was sent to the Fifeshire Coal Owners' Association:

> That the General Secretary be instructed to write to Mr Connel calling attention to the long hours which are being worked at several of the collieries where coal-cutting machinery has been introduced, and to request that the coal owners should make an effort to so arrange the work as to conform to the eight hour day where such machines are in use. Also that all managers not connected with the Coal Owners' association be written to in similar terms, This board being of the opinion that the evil arising from the practice of working long hours is becoming so serious that it must be tackled with a firm hand all round, so that the eight hour system may be preserved.[12]

It should be noted that the Fife coalfield had traditionally worked an eight hour shift, having won this concession in 1871. Miners in this area saw the move to modern mining practices as a serious threat to traditional work patterns which would result in an increase to the duration of the customary work shift and thus increased burdens for mineworkers.

Mechanisation of mining methods in Scottish pits resulted in the intensification in work effort for miners, not only through an extension in hours worked but also from the increased intensity of the work, that is, work in the pits became much more onerous. Campbell has noted how the move to machine mining resulted in miners having to produce 18 to 20 tons per shift.[13] This represented an increase of more than six fold on their traditional output of three tons when cutting coal by hand. Certainly the actual cutting process had been made easier through the adoption of machine cutters but the physical burden of ripping and loading the coal had been increased significantly.

Technological innovation in mining practices also resulted in an increased tempo and pace of work in the pits that also led to an intensification of the miner's work. Colliers had now to keep pace with the machines. They were becoming, as Redmayne noted, 'a mere cog in the wheel'.[14] A Clarke noted at an annual conference in 1933 that mineworkers in Scottish pits were being increasingly paced by the machine. The following comment by Clarke shows how far he thought the miner's job had changed and, more importantly, how the machine governed the miner's daily efforts:

> With the development of machinery in coal production the mineworker of today finds himself facing problems that a generation ago were almost unknown. The miner, or coal hewer, has given place to the Machine, and in consequence, he is becoming more and more part of the mechanism, compelled by the process of which he becomes a part only. His individuality no longer counts. He has his every action determined and regulated by someone, usually a contractor. He is not to reason WHY, but to keep himself in unison with the rest of his fellow workmen, with the one and only object in view - greater and still greater output.[15]

Intensification of work was not confined to face workers in the pits. Haulage and surface workers also witnessed changes to their work due to the introduction of new technology. Many changes took place to the operations above ground in the mines. Innovation in the methods of screening and sorting coal led to speed-up and intensified work practices for pithead workers as the following statement illustrates:

> Coal comes past me on an endless belt, and it is my duty to separate any dirt there may be from the coal. The belt sets the pace at which I must work. I have no feeling of power when working at the machine: on the contrary, I feel dwarfed, and I feel that the machine, instead of serving man, has become his master.[16]

Haulage workers also experienced an intensification of effort partly because of the piece-meal fashion in which technological change was introduced into the mines. For instance, improvements in coal cutting and in winding coal to the surface pre-dated innovation in underground haulage methods. This resulted in bottle-necks at the pit bottom which increased the workload of the putters, whose job it was to transfer the coal from the hutches from the face and load the coal into the cages at the pit-bottom. Innovation at the coal face meant the tubs or hutches were coming from the face at a faster rate than had previously been the case and consequently were always waiting to be unloaded while those at the pit shaft were always needing to be filled. One underground haulage worker complained that the combination of these two factors radically transformed the labour process:

> one machine was vomiting more than I could clean up, while the other had a larger mouth than I could fill. The outcome of this was a constant worry. I was working always at top speed without any sense of rhythm. I often wished the machines, and the men who made them were in hell, burning. Until they improve on methods of getting coal from the coal face I shall always regard machines in the mine as a nerve-racking, soul-crushing element.[17]

Intensification of effort was also influenced by the production method. Contracting of places and coal seams was long established in Scottish mines. Under this system a section of the mine would be leased by the coalowner to a sub-contractor. The contractor employed miners to work the section. He maximised his profit by employing as few workers as possible and driving them as hard as he could. Some coalowners argued that contracting in hand-worked sections was on the decline in the years before the Great War.[18] At the same time, however, coalmasters were adamant that contracting was the best method for machine mining. Indeed, this production method was central to the Scottish colaowners' strategy for mechanised mining, they actively sought to exploit the new technology using a system of extended sub-contracting.[19] Contractors not only exploited those in their charge they also set the work pace.[20] For example, a miner, who worked at the Lothian Coal Compny's Newtongrange mine, tells of how the contractor set the pace of work for the fillers by demonstrating the rate he wished coal to be shoveled onto the conveyor. The fillers had to maintain this tempo of work throughout the shift.[21] If miners failed to comply with the conditions set by a contractor, financial or otherwise they risked unemployment. Indeed, several miners lost their jobs at the Springbank and Greystanelea mines in 1906. These workers were in dispute over low rates paid by a contractor in a machine-run. The contractor dismissed the miners and replaced them with blackleg labour.[22] Thus, work in mechanised mines in Scotland became more intensive because of the pacing effect of machinery, which was exacerbated by the contractors' drive to increase output from machine faces.

The drive for increased production in mechanised mines was supplemented in the early decades of this century by the creation of a new tier of supervision in the mines – the overman. This grade of middle management comprised mainly young men with some technical knowledge. However, unlike the pit deputy (fireman as he was known in Scottish pits), the main concern of this strata of supervision was raised production, not safety.[23] Overmen have been described as a new grade of taskmasters who were integrated into the structure of colliery management and were responsible for exploiting the opportunities of mechanisation and labour's weakened bargaining position, 'they were men who feared neither God, nor the devil'.[24] The main function of this loyal stratum of pruduction (loyal to the coalowners) supervisors was increased output. This was achieved by drivng workers in the mines to the limit and by undermining and intimidating pit deputies. Thus this change in production management had the effect of increasing the already heightened pace of work in Scottish mines.

Consequently, it can be said that the move to modern machine mining practices in Scottish pits had significant and wide-reaching effects on Scottish pitmen. Work underground became much more intensified. The hours worked by colliers could, and frequently were, increased due to mechanical failure which resulted in miners working up to sixteen hours per day, that is, double their normal shift. New mining methods, in many instances, also meant an increase in the physical burden of mineworkers. Much of the skill and mental labour of workers in Scottish mechanised mines had been seriously eroded whilst the manual labour quotient of pitwork had greatly increased. Not only had mine work become more demanding in a physical sense it had also become more psychologically stressful. Workers, more and more felt they were just a part of the machine. Machinery governed the length of their work shift, altered their normal work pattern through the introduction of the three shift system, extended use of sub-contracting and the introduction of overman dictated the pace of work in the mines, invariably to the detriment of Scottish mineworkers.

The Impact of Modern Mining Methods on Workers' Control at the Point of Production.

The greater diffusion of machine mining technology throughout Scottish mines led to a decline in the amount of control that colliers exercised over their work and in the workplace. The traditional system of hewing coal by hand, as we have seen, was one whereby miners held a great deal of autonomy over how the work should be carried out. Mineworkers under this system worked in small groups and played a significant role in deciding how the work should be executed. They worked the coal without a great deal of supervision. Indeed the main duties of firemen and deputies in mines where traditional hand-hewing was practised were mainly related to the safety of mineworkers, not to discipline. (It should be noted, however, that haulage workers encountered closer supervision, mainly because these workers were paid day-rates, whereas face-workers were paid under a piece-rate or tonnage-rate system which required less direct supervision to ensure the work was completed on schedule). The advent of machine mining necessitated greater control of operations below ground. For instance, if optimum efficiency was to be obtained when coal cutting machinery was being used it was imperative that the coal face advance at a uniform rate. To achieve this a larger number of underground supervisors was required.[25] The move to the three shift system also led to an increase in supervision as it was vital that each shift completed its allotted work tasks on schedule otherwise the succeeding shift would be held up.[26] Firemen and deputies now played a more pro-active role in mining. Co-ordinating operations which necessitated increased discipline was now the main priority of these workers. Increased supervision along with the pressures of working new shift systems, new machinery and the pacing and speed-up this entailed led to a deterioration in industrial relations in the Scottish coalfields as miners throughout the industry fought to retain the control they had in the workplace.

Goldthorpe has argued that the move to a cycle system of production saw a concomitant attempt to curtail the freedom of mineworkers. Management sought to institute a regimented working system. Discipline was tightened on issues such as time-keeping and absenteeism. Miners could no longer work the hours that suited them. For example, traditionally colliers could choose the length of their working day and working week. That is, if they were satisfied with the amount they produced in four or even three days they could settle for a shortened week. Similarly they could shorten or lengthen their daily shift. This was no longer possible under the cycle system as each shift had to be completed on schedule. Consequently, trouble arose when management imposed a tighter discipline regime.[27] Furthermore, miners resented not being able to work *their place* or being told how to do their job. As the move to the cycle-system gathered pace in the inter-war years this source of conflict became more common. Goldthorpe highlights the fact that, 'it was no longer possible for a man to have a definite place of work or job of his own...The cycle system inflexible in itself cannot permit such inflexibility in the deployment of the labour force.'[28]

This author also points out that supervisors in Scottish pits were generally 'ignorant, unprincipled, dishonourable, blaspheming men... most useful to the deputy's primary function of hounding the men'.[29] Enforcing stricter discipline in the pits was easier when economic conditions gave management the upper hand in the labour relations arena. For instance, from the mid-twenties to the mid-thirties high unemployment meant workers had little bargaining power, little chance of opposing changes in the pits:

> A labour surplus makes it tempting for a supervisor to enforce discipline and to supply motivation by wielding the 'big stick'...and under the strain of the cycle control it seems that many deputies were forced into the role of slave drivers.[30]

Mine management also used new technology to circumvent and curtail opposition from miners in various areas of conflict within the pits. For instance, the fixing of tonnage rates was one issue which invariably caused unrest between management and mineworkers. The situation at Afton No.1 colliery in Ayrshire provides a typical example. In 1939 a section at this mine was in dispute over ton rates in one of the pick places. That is, in one section of the coal face where the coal was still being cut by hand. Failing to get the colliers to accept the new rate mine management decided to sidestep any further dispute by switching to coal cutting machines. The dispute, needless to say worsened when management adopted this tactic.[31] A similar situation occurred much earlier, in 1904, at the Gateside colliery in Lanarkshire. The county union (LMCU) had blocked a section (refusing to let the men work this area till the dispute was resolved) in November of 1903 over disputed ton rates. At the end of May 1904, the mine owners intimated their intention of bringing in cutting machines. The union made the strike official paying strike money to the men involved.[32] Much the same scenario took place at the Fortissat Colliery, Lanarkshire in 1910.[33] Management adopted such tactics in a bid to diminish the power and control of organised labour in the mines.

The introduction of mechanised mining into Scottish pits could have an effect on traditional custom and practice, usually to the detriment of the miners. For instance, the payment system at Annbank Colliery in Ayrshire for working a three foot seam in the Jewel section of the mine was as follows. Where the seam was three foot high or above the miners got one shilling and seven and a quarter pence per ton. For each inch below three foot the miners received a further $^{7}/_{8}$ of a penny. Some time after the seam was being worked by machine management decided to stop paying the men for filling gum, the residue of small coal produced by undercutting the seam, the width of the undercut being three to four inches high. To counteract this reduction in payment mineworkers argued that the seam should now be calculated from the top of the cut. Thus, they would qualify for the additional payment as the coal they were being paid to cut was now below three feet.[34] This example demonstrates the effect of new technology and the work systems which came with it on traditional custom and practice and how it was used to undermine workers control in the mines.

A strike at James Nimmo's Auchengray pit in August 1914 provides further evidence of the connection between the diffusion of modern mining practice and the assault on workers control in the mines. This dispute started, again because the colliers were dissatisfied with the tonnage rate in a hand worked section of the pit. The men struck work. Management decided to extend a nearby machine to incorporate the disputed section of coal face. The union (LMCU) blocked the section and claimed the company had no right to take by machine coal which had previously been cut by hand. The coal owners on their part disputed the actions of the workmen in interfering with their right to manage the pit. Nimmo sought and received the full support of the Lanarkshire Coal Masters' Association(LCMA) including compensation for loss of profit during the dispute. The association acknowledged the cost of compensation would be low as the tonnage involved was trifling but they considered the principle important as it might have a *larger and more serious application.* This is an explicit example of direct conflict for control in the mines and also demonstrates the way new technology could be used to breakdown the control mining labour had at the point of production.[35]

Mechanisation and the Tendency toward Deskilling.

Methods to define and quantify skill are extremely varied and open to criticism. C More argues that skill is acquired in various ways. For instance, 'regular service,' where a novice embarks on a period of formal training, the most common method being an apprenticeship. 'Migration' is a method whereby skill is learned by moving from company to company, machine to machine or, as was the case in some mines, from job to job. Skill can also be acquired by 'following-up.' This is where a person learns the skills of a trade from being a member of a work-gang or as an assistant, or mate, to a skilled worker. 'Picking-up' was a fourth method, which was a combination of the other three but was one in which there was little chance of progression to skilled worker. More contends that learning a skill in coalmining was a combination of regular service, migration and following-up. He did not see picking-up as being applicable to mining as 'there was a definite expectation among most learners that they would progress upwards'.[36] This definition is reasonably accurate for the Scottish mining industry. The following statement can be viewed as a combination of regular service and following-up.

'Two years was enshrined in the Coal Mines Act of 1911 as the period during which a trainee had to work alongside an experienced hewer before he could work himself.'[37]

Added to this in many instances, and as was quite common in Scottish pits, was a short period employed in haulage work below ground. If the trainee started at a early age his first job, before moving on to haulage work was as a trapper. This task involved opening and closing ventilation doors, or traps, during haulage operations.[38] This fits well More's definition of learning through migration. This description of the way miners acquired their skill is applicable when considering hewers, that is, miners who used traditional hand-hewing methods to extract coal. The way in which coal cutting machinemen learned their 'skill' is open to debate as will be seen below.[39] This definition will help contextualise whether new technology, as introduced into Scottish mines had a deskilling effect on mine personnel.

There appears to be some evidence that Scottish coal companies did not regard machine mining as a deskilling process. In general the coal cutterman was still regarded as being a skilled workman. One method, which can be used to classify skill, is wage levels. It has been argued that wage levels are an unsuitable indicator of skill because factors other than skill can raise or lower wages. For instance, the type of payment system in operation can affect wages. Piecework can result in higher earnings through increased effort not increased skill. Levels of collective organisation can also affect wage rates. Areas or industries where labour organisation is well advanced can have an impact upon remuneration levels whether the workforce is skilled or not. The level and proximity of other industries also influence wages. That is, if there is a high concentration of industry within a region competition for labour will be high and, hence, wages will also be high. Thus, wage levels, in this instance, may have no bearing whatsoever on skill levels.[40]

Despite these arguments wage data can still be of value. It provides an insight into the way coal companies regarded skill among the various jobs within mining. For example, evidence on wages in Scottish pits submitted to the Coal Industry Commission of 1919, (the Sankey Commission), indicates that Scottish coal owners, at any rate, classed coal cutting machinemen in the same category as miners (hand-hewers) and fillers.[41] These grades of workmen, as well as the highly skilled job of mine driver, were all on the same basic wage rate. This does not necessarily mean all grades were of equal skill. It does, however, indicate that the employers valued them in a like manner. From a monetary point of view it appears that coal masters did not regard machinemen as being less deserving than other grades of workmen in the pits.

Far from valuing machine cuttermen in a like manner to other tradesmen in the industry some commentators looked on the job of operating a machine cutter as requiring a higher level of skill. In 1912 S Mavor regarded cuttermen as highly skilled workers but also noted that those in control of operations in the mines needed a high level of technical expertise, 'The machinery must be controlled by a higher order of executive ability and operative skill...The organisation and personnel which were good enough on hand-worked faces are not good enough for machine mining.'[42]

The lack of technical 'know-how' at managerial and supervisory level was commentated upon later in the period. In 1927, G M Guillick in his paper, *Machine Mining*, presented to the Past and Present Student's Association of

Wigan Mining College, highlighted this deficiency. Guillick was comparing the level of mechanisation in mining in the USA with that in British mining and argued that one reason for the former country's lead in machine mining was due to the lack, in British mines, of suitably qualified managerial personnel. Guillick stated, 'In this country there are frequent requests for a man who thoroughly understands the installing of coal cutters and conveyors and the organisation of machine mining to take charge of this work.'[43]

A lack of skilled personnel has been seen by some commentators as a reason behind the adoption of new technology in coal extraction. J R Kirkby, of the Wemyss Coal Company stated at a meeting of the Mining Institute of Scotland in 1926:

> America had been forced into machine mining because she had been short of skilled miners. In Scotland they were getting short of skilled miners too, otherwise he thought it would still pay better to work by hand seams which were over thirty inches thick.[44]

G L Kerr saw the lack of skill among Scottish pitmen as a major inhibiting factor to the development of mechanised mining in Scottish mines:

> There has been the difficulty of getting a sufficient supply of skilled men to operate and supervise the machines and, consequently in many cases incompetent men are operating machines with unsatisfactory results.[45]

This quote is taken from the fifth edition of Kerr's book, *Practical Coal Mining*, written in 1914, the first edition having been published in 1900. Considering that machine mining was in an embryonic state at the earlier date it is not surprising that comments on the lack of skilled personnel were made. Kerr, himself, recognised the value of trained personnel and the difference they could make to operations below ground. He goes on to say:

> The machineman should be carefully selected, and every encouragement given to suitable men to remain, as a frequent change of men for such work often means decreased efficiency and much worry.[46]

This statement not only indicates that some people in the mining industry regarded coal cutting machine operators as being highly skilled workers, assets worth retaining within the industry, but also that machinemen, because of these newly acquired skills, had better employment prospects and a better chance of remaining in employment when trade was slack.

The value of a highly trained workforce was recognised by others in the Scottish coal industry. The minute books of the Lochgelly Iron and Coal Company of Fife first record the purchase of a coal cutting machine for their Minto pit in 1905.[47] These records also make reference to the company having organised a training course for coal cutting machinemen at this same mine in 1907.[48] Across the Forth the miners in the Lothian coalfield appear to have viewed mechanisation of the pits as a skill and status-enhancing phenomenon. This is despite the following description of the consequences of machine mining within the district:

> By 1939 most of the coal was undercut by machine, brought down by shotfirers and loaded onto face conveyors - 150 to 750 feet long by teams of fillers. Mechanisation replaced 'the complete collier' with mechanics who worked and serviced the machines and others - primarily manual labourers.[49]

P M Bonsall in his comparative study on the Somerset and Lothian miners has argued that the Lothian miners working in mechanised pits regarded themselves not as 'machine-minders,' indeed, they saw mechanisation as offering a step-up through the opportunity of acquiring new skills not as a deskilling process.[50] He further contends that mechanisation of the Lothian coalfield could have made the industry more attractive to potential recruits and more interesting to those already in employment.[51] Penn and Simpson also argue that the move to machine mining led to enskilling not deskilling. They see mechanisation as increasing both maintenance and production skills. The new system created the need for new skills – electricians and mechanical fitters to maintain the equipment. New production skills, cuttermen, rippers and packers were also created.[52] It would seem then, in some quarters at any rate, the switch to mechanised mining techniques by Scottish coal producers led to an increase in skills for some workers in the industry. However, other commentators argue to the contrary.

Alan Campbell has stated; 'perhaps the most immediate and obvious effect of mechanisation was the deskilling of the hewer'. Colliers now found that physical strength was more important than the skill, knowledge and experience that had proved so invaluable in the past. Working coal under the old hand-holing system a hewer and his filler would normally produce a daily output of six tons, that is, three tons per man. After the introduction of machine cutters both workers were expected to produce between 18 and 20 tons per shift. Over and above this the hewer also had to draw his coal along the face to the haulage roads. Thus machine mining imposed a much greater physical burden on mineworkers. As Campbell maintains, machines eliminated most of the skill attached to the work and deprived the coal face miner of his hitherto privileged position of being the superior man in the mine. Indeed, the once skilled workman was now reduced to the status of a 'living tool'.[53]

The idea that mechanisation would lead to deskilling within the industry was one of long standing. J Hyslop, in his manual, *Colliery Management*, published in 1876, noted one advantage of coal cutting machinery was that 'an inferior class of men could do the work'.[54] The tendency of new technology to result in a lowering of skill and status was also noted by Thomas Mann in the last decade of the nineteenth century; 'labour saving machinery is reducing the previously skilled to the level of unskilled labour'.[55] Mann is cited in I Benson and J Lloyd's book *New Technology and Industrial Change*. These authors give an example of the deskilling effect of technological change on labour in the engineering industry during the inter-war period. However, it should be noted that counter-arguments exist. Several commentators - Zeitlin in engineering and Reid and Lorenz in shipbuilding - contend that new technology resulted in skill enhancement rather than deskilling.[56] Nevertheless, Benson and Lloyd's work provides evidence which shows how the structure of the manual labour force changed as the engineering industry became more and more mechanised. In 1914 the ratio between skilled, semi-skilled and unskilled in engineering was 60:20:20. By 1933 this had changed to 32:57:11.[57] The change emphasises the growth of semi-skilled machine operatives. The figures also show that 75 percent of this growth resulted from a downgrading in status of workers formerly classed as craftsmen. T Cutler argues that the impact of technology on traditional work practices can be viewed as, 'the replacement of the relationship between labour and tools by the relationship between labour and machines. Basically this comes to the replacement of the craftsmen by the machine operative.'[58]

The deskilling effect of mechanisation had the same pronounced effects on the work of colliers as it had on workers in other industries. Sir R A S Redmayne, mining engineer and a former chief inspector with the Mines Inspectorate, noted how the work of the miner was, 'gradually ceasing to be individual, the worker is more and more becoming a mere cog in the wheel'.[59] The decline in skill levels is one of the major tenets of Walter's thesis on the coal miner and the changing labour process in the twentieth century. Walter notes:

> As technology has advanced, the individual miner's ability to win coal has declined. No individual today has sufficient knowledge to operate all the tasks associated with mining which he could to a greater extent previously. As the mechanical ingenuity of technology has progressed the miner's ingenuity has declined. The increased technological ingenuity of machines, produces then at each stage of progress in mining techniques, a regressive degradation of the skills of the craftsman miner.[60]

Much of Walter's thesis deals with mining in the post nationalisation period but the above conclusion still holds true for the situation in the early decades of the twentieth century in Scotland, given the advanced state of mechanisation. In 1913, for instance, Sam Mavor whilst presenting a paper to the South Wales Institute of Engineers, commented that the men who worked coal cutting machines would require, 'different training and a higher order of technical skill'.[61] He did, however, also note that he saw mechanisation as producing an increased number of unskilled workers and a decrease in skilled miners in the industry, that is, amongst the many other mineworkers who were not fortunate enough to become machinemen. It should be noted that Sam Mavor, although an influential figure within the Scottish, and indeed the British mining industry during this period, was part of the Mavor and Coulson company - one of the leading manufacturers of machine mining equipment. Maybe it should not come as any great surprise that he portrays those working machine mining equipment as requiring a high degree of skill. Later in the period the editors of the *Colliery Guardian*, in a series of articles entitled *Men and Machinery* in 1936 stated:

> but the truth is that both the value and skill of the average workman employed at a coal mine tend to decline as the machine comes to take a greater part in the process. We have almost reached the stage where the personnel comprises a few highly skilled operatives and a vast number of unskilled labourers.[62]

F Zweig, in his book *Men in the Pits*, highlights the difference between the old hand-working system of winning coal and mechanised coal extraction. He states:

> The getting of coal by hand, with all the cutting, shovelling, ripping, packing, drawing-off etcetera; was a craft, an art, while now all the jobs are specialised, and have become monotonous. There are cutters, who are cutting the coal face by machine, and borers, and shotfirers, and fillers, beltmen or panturners, etcetera. The collier of today in a mechanised colliery is doing practically nothing but shovelling - shovelling all the time. How can you expect him to take an interest in his job...An old collier could take his time, there was no such thing as rush and strain as there is now, with the conveyor and the twenty-four hour cycle.[63]

Zweig was writing in the late forties but considering that little change in the diffusion of mechanised technology took place during World War II his description is applicable, at least, to the end of the period of this investigation. The above quote not only emphasises that mechanisation led to a deskilled workforce but also highlights the increased burden and intensified work systems that technological change brought to the mining industry.

D Gemmell, a director of the Summerlee Iron and Coal Company Ltd., was also aware of the deskilling tendency of machinery. In a speech delivered to a joint meeting of the Scottish branch of the National Association of Colliery Managers and the Association of Electrical Engineers in 1921, Gemmell noted how:

> he deplored the appreciable decline in the capacity and ability of pitmen. Apart from the few trained workers at special occupations he found that the face worker of today has deteriorated into an unskilled labourer...The curse of the machine in general is the monotony which it entails, almost invariably producing a degradation of skill and morale driving away men of the higher standard of intelligence, and hampering the efficiency of the machine as a means towards economy, because it is left in the hands of inferior workmen.[64]

Gemmell, then, sees mechanisation resulting in a decline in skill levels not only because the machine has taken over the task of undercutting the coal, which accounted for much of the miner's skilled work but also because the monotony of undercutting by machine was such that it drove away the more intelligent workman.

The wider use of machines below ground resulted in changed working methods. The traditional method of mining coal was the pillar and stall system, or stoop and room as this was more commonly known in Scotland. This method consisted of two distinct operations. First colliers would cut narrow passageways - stalls or rooms through the coal. When this was completed a second set of rooms would be cut a right angles to the first. A plan view of the workings at this stage would show a honeycombed or lattice formation. The interlacing of the rooms produced rectangular pillars or stoops of coal. These pillars varied in size, their actual dimensions having been previously determined to suit the prevailing geological conditions. A team of two or three miners who would extract the coal and then allow the roof to collapse behind them then worked the pillars or stoops.[65] These colliers would perform all the tasks needed to bring down the coal. As A R Griffin notes, there was little need for specialisation of mine labour when working this type of system.[66]

The longwall system was the other main system of coal extraction. This was the method, which was invariably adopted when coal cutters and conveyors were introduced to the pits. In this system the full length of the coal seam is usually extracted in one operation. The length of the coalface, 100 yards being fairly typical in Scottish pits, is worked by large teams of mineworkers. In the mechanised system the coal is undercut by machine. A full shift is required to perform this part of the cycle. The coal is then brought down using explosives. Holeborers would drill holes at intervals in the seam and then the shotfirer would set charges that brought down the coal. Next, the fillers would load the mineral into tubs or onto conveyors to be transported to the pit bottom. This work system was a major contributing factor in the deskilling process in mining.

This method of coal extraction resulted in the specialisation of tasks and division of labour. The miner working stoop and room performed all or most of the tasks needed to 'win' the coal. That is: he undercut the seam; propped his place; bored the coal for explosives; set and detonated his charges; ripped down the coal; and transported the mineral to the main roads where other groups of workers would transport the coal to the pit-bottom and then to the surface. Under the mechanised system of coal mining the majority of these functions became specialised,[67] the result being that the miner was no longer 'the complete collier'.

The introduction of machinery and new work systems into the pits did force some of the traditional hand hewers to quit the mines that had adopted new methods and seek employment elsewhere. John MacArthur, one the Fife miners' leaders in the inter-war period, relates how his father and brothers left their jobs at the Wellsgreen Colliery in 1914 because they were fed up working in the unfamiliar conditions of a machine mining section. Not only was the work a completely new experience for these miners but so too was the terminology which accompanied the new process, as the following anecdote illustrates. The contractor in charge of the machine section told the young John MacArthur to tell his father to lift his *'pugs.'* By this the contractor was referring to the small portion of coal that the machine had failed to cut and which required to be cut by hand. MacArthur senior, however, was unfamiliar with the term but immediately took it to mean he was to lift his *'graith'* or tools, that is he thought he had been dismissed. He then happily said to his son; 'that's the best thing you've said today. He ye are, (passing his son his tools,) lift them and put them in the tub'.[68] MacArthur and his sons then returned to the surface and went in search of work at another colliery, one where hand-hewing of coal was the norm. As machine mining became more commonplace and as the depressed state of the industry deepened during the twenties and thirties there was less opportunity for mineworkers to move to pits still practicing hand-hewing. Consequently, the deskilling process was ongoing throughout the period under discussion.

This factor did not go unnoticed by mining trade unions. In his presidential address to the annual conference of the Miners' Federation of Great Britain at Edinburgh in 1910, Enoch Edwards noted that it had been supposed when dealing with coal cutting machinery that it could be done by, *'a* sort of rough and ready and tumble labour'.[69] Opposition to unskilled men coming into the industry was an issue of long standing in mining and frequent references to this can be found in the records of the various mining unions. For example, minutes of the executive committee of the Mid and East Lothian Miners' Association (MELMA) for 1900 make reference to a motion submitted by the Lanarkshire Miners' County Union (LMCU) with a view to preventing unskilled labour being employed in the mines.[70] In 1902 one of the proposals of the Scottish Miners' Federation (SMF) to be raised at the MFGB's forthcoming annual conference emphasised that action was needed to protect the mining communities from the influx to the mines of unskilled labour.[71] The Lanarkshire union submitted a similar resolution to the MFGB in 1906 that emphasised the presence of unskilled workers underground.[72] The annual conference of the MFGB in 1910 saw the following proposition put forward by the miners' of Yorkshire:

> that a clause be introduced in the next Coal Mines Regulation Act making it illegal for unskilled workmen, (whether they be home or foreign workmen) to work in our mines, as we are of the opinion that unskilled labour is absolutely unnecessary and dangerous to the whole of the men working in our mines.[73]

It should be noted that Scotland seconded the proposal. At that time the Scottish and Yorkshire coalfields were the most highly mechanised in Great Britain. Indeed in 1909, Scottish pits are recorded as using 483 coal cutting machines which represented 25 percent of the total number of machines in use in British coalfields. Yorkshire was the second highest mechanised mining coalfield employing 258 coal cutters in that year.[74] Four years later, 1913, these areas still topped the mechanisation 'league table' when Scottish mines employed 876 cutters and 125 face conveyors and Yorkshire is recorded as having 673 cutters and 86 face conveyors in operation.[75] This proposal underlines the fact that machine mining techniques and the concomitant use of unskilled men were perceived as a threat to traditional working methods and skill levels within these two areas. This threat was undoubtedly regarded as all the more threatening when cognizance is taken of the speed of mechanisation, as implied by the growth in machines over such a short time period.

Bonsall's contention that miners in the Lothians considered new technology as enhancing their status because of the increased skills this work required may well be correct. But it should be noted that he was referring to colliers in the 1940s. These men would have come into the industry when the mechanisation process was at an advanced state in that district. In 1938, for example, 76 percent of mines in Mid and East Lothian employed coal cutting machines and 62 percent of mines employed conveyors at the coal face.[76] Consequently many of these colliers would have been unfamiliar with the hand-hewing method of coal extraction. Thus having started from a different benchmark, machine cutting and conveying of coal would have been the 'norm' for these workers. This would, undoubtedly have influenced their attitude to mechanised production methods.

In a similar vein colliers who had been brought up in the old tradition would have been influenced by their induction into the industry. The introduction of new technology may well have had an adverse effect on the attitudes of these miners to mechanisation. Many of whom saw technological change threatening deskilling and possible redundancy. John MacArthur, for instance, who had learned his trade from his father in the traditional manner, still preferred hand-hewing to machine mining later in life. This fact was patently obvious as the circumstances surrounding his return to pitwork in the late thirties demonstrate. MacArthur had been victimised for his union activities and role during the 1926 strike and lock-out. It was 1938 before he got back to pitwork. When asked what jobs he could do in the mine MacArthur replied, 'I can do any job in the pit. The only job I don't want to go to is on a coal-cutting machine'.[77] A miner's attitude to mechanisation was, then, influenced by generational factors. It seems fair to argue that Lothian miners a generation or two before those Bonsall referred to may have had similar feelings about the introduction of machine mining techniques as those held by John MacArthur.

From the evidence above it seems appropriate to argue that the job of machineman, as Kerr and Mavor contend, was one which required a level of skill similar to that of the hand-hewer. However, the greatest majority of occupations in the mechanised mine were subject to specialisation and downgrading. Zweig's quote above best illustrates this point. His description of borers, who drilled the coal after it had been undercut by the coal-cutter, and the shotfirer who charged the hole made by the borer with explosive and then brought down the coal, highlight the extent of the division of labour in mining. The 'complete collier' had previously carried out these operations. His reference to the amount of unskilled labouring tasks, 'practically nothing but shovelling - shovelling all the time', indicates just how far the deskilling process had gone. The downgrading of pit labour becomes all the more apparent when it is recognised that for each machineman there were approximately 15 to 20 fillers - many of whom had previously been hewers and hence, 'superior men in the pit'.

The Effect of New Technology on Employment.

When the impact of the spread of mechanisation in Scottish pits and its effect on levels of employment is considered once again controversy is encountered. Some commentators argue that the introduction of new technology in the form of coal cutting and conveying machinery to pitwork would cause little unemployment within the industry because new work practices created additional jobs. For example, W Hay emphasised this point in his presidential address to the Sheffield University Mining Society in 1933. Hay noted that mechanisation created new work opportunities in electrical and maintenance fields. Furthermore he stated:

> at the same time we relieve the miner from the most dangerous and arduous part of his occupation. In other words, the displaced miner ultimately becomes a skilled artisan and his duties are performed in a more congenial and less dangerous atmosphere.[78]

Charles Latham made similar claims regarding the impact of mechanisation to pitwork some thirty five years before Hay. Latham argued that machine mining would improve safety conditions below ground and that employment levels would increase overall when the numbers needed to tend and move cutting machines and rails were taken into consideration.[79] Consequently, Hay saw mechanisation of the coal mines in a very positive light. Not only did new technology create employment it also increased skill levels and improved the working conditions of colliers underground. Latham also acknowledged the beneficial effects of machine technology on safety and increased employment levels. However, he implied that the new jobs would more likely require a lower level of skill - that is along the lines of machine minders and ancillary labourers. Whatever the effect on skill levels in the pits, both commentators clearly state that mechanisation would result in increased employment opportunities.

In 1915 the *Colliery Guardian* highlighted the findings of a paper, *The Reduction of Working Costs at the Coal Face*, written by S H Cashmore. Cashmore carried out a theoretical comparison of three systems of coal extraction; traditional hand hewing, machine-cut and hand-filled and machine-got and filled by conveyor. The exercise was based on a 100 yard seam where the coal was five and a half feet thick. The seam was uninterrupted by faults, holing was moderately good, the roof was fairly strong. The seam was worked on a single shift system of eight hours per day for five and a half days. Cutting by traditional methods the seam was divided into three stalls worked by three men per stall each producing 3.5 tons per shift. This equated to 173 tons per week for nine men or 19.2 tons/man/week. Where the coal was undercut by machine and filled by hand the coal face was again divided into three stalls. This time each stall was worked by four fillers - the extra worker was needed for the additional filling due to the increased output from machine cutting. Added to this was the machineman, giving a total of five men per stall or fifteen in total. The weekly output was 480 tons or 32 tons/man/week. Twenty five men were employed in the machine-cut and conveyed system, sixteen filling and nine engaged in the cutting operation. Using this method 1200 tons was produced per week or 48 tons/man/week.[80] In the simplest terms this evidence shows that staffing levels required to work a coal face of 100 yards increased nearly three fold when the work system was changed from hand-hewing to fully mechanised production. On the face of it Cashmore's data supports both Hay and Latham's view that mechanised mining would lead to increased opportunities for mine labour. Cashmore's data, however, also highlights the cost effectiveness of mechanised production. Far fewer workers are required to produce a given amount of coal using machine mining. In other words, a collier in the fully mechanised work system produces more than twice the output of a traditional miner, that is, 48 tons per week compared to 19.2 tons. In efficiency terms the modern cutting method requires less than half the workforce to produce a given quantity of coal. Consequently, the introduction and continued diffusion of new technology in mining resulted in labour shedding.

Evidence to support the labour shedding effect of mechanisation in the mines is abundant. The frequency of comments emphasising the labour saving effect of new technology increases as the period under investigation unfolds. This is not surprising as the rate of diffusion of coal cutters and conveyors increased in a like manner. However, evidence is still to found of the labour displacing effect of new technology early in the period. For instance, in 1895 employment levels in Scottish mines were noted as having decreased by 4956 persons. This was attributed to two main causes; short-time working within the industry and the introduction of machines into the pits.[81] The downward trend in employment in mines in the western Scottish coalfields continued the following year as R Ronaldson, the inspector of mines noted. That year the number employed below ground fell by 1179 workers.[82]

Workers in the industry did not miss the potential threat to employment from new work processes. Indeed, the perceived opposition of workers to mechanised production methods has been attributed to the threat posed by new technology to employment levels. Evidence presented to the Miners' Eight Hour Day Committee serves to underline this fact. G A Mitchell of the Lanarkshire Coal Masters' Association suggested that one reason behind the workers opposition to coal cutting machinery stemmed from the threat of labour displacement.[83] This fact was also highlighted in a series of articles on mechanised coal cutting in the *Colliery Guardian* at the turn of the century. One article on the reluctance of workers to use machinery noted that:

> This reluctance is, as usual, made up of two factors - the natural reluctance of workmen in this country to adopt the use of machinery of any kind, on the ground that the machine will displace a certain number of men and that the machines undoubtedly punished the men who used them, until they got into the way of using them.[84]

However, it is in the later period that the threat to staffing levels becomes much more apparent. J Jones president of the Miners' Federation of Great Britain noted in his book '*The Coal Scuttle*' in 1936 that:

> We have a further great cause of unemployment in the increasing mechanisation of the mines...this has made great strides in the British coal industry during the last ten years and, as it has occurred during a period in which markets have been restricted, its effect has been to displace large numbers of men in every coalfield.[85]

The diffusion of cutters and conveyors accelerated as the period under investigation unfolded and the impact of new technology was felt by more and more workers in the mining industry. It is not surprising, therefore, that adverse comment about the impact of machines became more common from mineworkers. The increased adoption of conveyors, which were seen as a greater threat to staffing levels in the latter part of the period also, helps to explain the growing incidence of protest. P B Long in his study of the Scottish miners during the 1925-1939 era noted that the number of conveyors in Scottish pits increased sharply between 1925-27.[86] Long notes that conveyors were 'adopted primarily as a means of shedding labour'.[87] This author goes on to link levels of protest against mechanisation and the labour shedding effect of machine mining:

> There is little evidence to suggest that they [miners] opposed the introduction of mechanisation during the twenties and before, although they were generally more opposed to mechanised conveying than to mechanised coal-cutting due to the greater loss of jobs involved.[88]

Can then a case be made for technological unemployment in the Scottish mining industry during the period of this investigation? A J Taylor has argued that up to the outbreak of the Great War, at any rate, employment levels in the British coal industry increased at a much faster rate than the national average. Indeed, between 1883 and 1913 employment in mining increased from 492,000 to 1,107,000. This represents an increase of 125 percent. The total working population during these years rose by less than 40 percent.[89] Data in tables 2.1.16 and 2.1.17 show an increase in employment for the years 1890-1914 in Scottish and British mines of 80 and 79 percent respectively. This data indicates that the first part of the time period of this study was one of rising job opportunities and therefore there is little evidence of technological unemployment.

A closer look at individual county employment figures indicates that although striking regional variations existed the trend was invariably one of increased employment levels. Table 3.1 depicts the percentage shift in numbers employed for the various Scottish regions, the Scottish aggregate figure and the British averages for the years 1890-1914. The second column shows the level of mechanisation, that is the percentage of mines using coal cutters in 1914. Due to the paucity of data it has been impossible to produce a percentage change in levels of mechanisation for the 1890-1914 period. Still the figures for 1914 allow an inter-county comparison to be made. All areas with the exception of Clackmannan, which experienced an 8 percent drop in numbers employed, witnessed increased job opportunities during the period. At the outset it must be made clear that no simple relationship exists between employment and mechanisation levels. The different characteristics and experiences of each of the regions in part explain this. For example product markets differed for the eastern and western coal fields with the west still closely linked to the iron and steel industry at this time, whereas coal exports were more important to eastern coal producers. The level and extent of development of new pits and coal fields also impacted on employment levels. However, taking these facts into consideration it is still very obvious that the two counties that experienced the largest growth in employment, Haddington and Fife, were also the areas which had adopted mechanised mining methods to the greatest degree. Haddington saw a 240 percent increase in mining jobs over the period and in 1914 the county was the second highest most mechanised mining district in Scotland. The most highly mechanised coal producing area of Scotland was Fife, which witnessed a 204 percent growth in job opportunities. These two counties were noticeably ahead of the others in both increased employment opportunities and in the adoption of new mining methods. From this evidence the introduction of mechanised coal cutting techniques to mine work resulted in increased not decreased employment opportunities for a significant proportion of Scottish mineworkers.

TABLE 3.1 EMPLOYMENT TRENDS AND MECHANISATION, 1890-1914,

County	Percentage Increase Nos; Employed	% Mechanisation, 1914
Ayrshire	30	19.2
Clackmannan	-8	50.0
Dumbarton	37	16.6
Stirling	94	37.2
Edinburgh	105	40.7
Haddington	240	63.6
Fife	204	70.5
Lanark	59	41.9
Scotland	80	42.0*
Great Britain	79	16.9*

Clackmannan witnessed a 8 percent drop in employment over the period.
*Level of mechanisation for Scotland and England and Wales is for 1913.
Source: Employment data calculated from figures in tables 2.1.7 to 2.1.17.
Level of mechanisation from data in tables 2.1.5 and 2.1.6.

Turning to the inter-war period, data in table 2.3.3 and in the annual reports of the Mines Inspectorate highlight the employment trends for the various Scottish counties, Scotland and Great Britain for the years 1919-1938. Numbers employed in Scottish pits fell on average by 36 percent between the wars, slightly greater than the English and Welsh average of 34 percent. Once more wide regional variations are evident within the Scottish districts. Employment levels fell in all Scottish regions except the small coal fields in Dumbarton which witnessed a slight increase of 5 percent. Pits in Clackmannan and East Lothian each lost 28 percent of their 1919 total. Mines in Fife, West Lothian, Ayrshire and Mid Lothian experienced a reduction in jobs of 21, 19, 18, and 8 percent respectively. Coal mines in Stirling shed the biggest percentage of labour - 54 percent of the 1919 total which translated into 6,500 mine jobs. However, by far the greatest loss of jobs occurred in the mines of Lanarkshire. Between 1919 and 1938 job opportunities for mineworkers in this county fell by 31,800 - 52 percent of the earlier total. The fall in employment in this county represented 59 percent of the total Scottish job losses for the period. Was this huge fall in employment in Lanarkshire the result of increased mechanisation of pitwork in this county?

For the years 1923-1932 Page-Arnot has shown that the Scottish mining industry as a whole was shedding labour faster than mines in England and Wales. Indeed, in this period one quarter of mineworkers south of the border experienced unemployment. In Scotland the figure was 33 percent. It could be argued that the higher adoption rate of mechanised mining in Scotland explains the greater loss of mining work in Sottish pits. However, a glance at table 2.3.6, which depicts the level of mechanisation for the counties of Lanark, West Lothian, Stirling, Dumbarton and Renfrew shows this area as one where the number of mines using coal cutting machines was, in fact, declining during the inter-war era.[90] Indeed, the number of mines using such equipment declined from 51 to 46 percent. This would suggest that technological unemployment was an unlikely factor in the declining employment opportunities in Lanarkshire and the surrounding counties.

However, further investigation shows that Lanarkshire and the surrounding counties, although an area which witnessed a contraction in mines using coal cutting machinery, was the coal field that employed the greatest number of mechanical conveyors in coal production. In 1938, mines in this district used a total of 352 conveyors at the coal face and 94 elsewhere in the pits. A comparison of the distribution of mechanical conveyors in the Scottish regions is shown in table 3.3 whilst table 3.2 depicts the trends in levels of employment and the change in the number of mines using coal cutting machines over the years 1921-1938.

Table 3.2 indicates that the region that experienced the fastest growth in mines using machine coal cutters was Ayrshire. It should be noted that Ayrshire was not the most mechanised area at the end of the period (Fife held this position with 86 percent of mines using cutters and 90 percent of total output coming from mechanised mines), but it was the district which witnessed the greatest change during the period. In 1921, 21 percent of mines in the Ayrshire region used coal cutters. By 1938 this had increased threefold. This region also encountered the second lowest loss of mining jobs. The Lothian district witnessed the next fastest rate of change in mines adopting mechanical cutting techniques - a 69 percent increase. This district had the lowest incidence of unemployment during the period, with jobs losses at 14 percent. The largest fall in employment opportunities was in the Lanarkshire region, with nearly half of all mining jobs lost over 1921-1938. This region also witnessed a decline in the number of mines using coal cutters, 10 percent fewer mines used cutters by 1938. This data supports the argument that mines which introduced new mining methods in the form of machine coal cutters tended to create employment opportunities for Scottish colliers.

Table 3.3 on the other hand provides evidence that new technology in the shape of mechanical conveying in Scottish mines led to dwindling job opportunities for mineworkers. Districts that utilised mechanical conveyors to the fullest extent, that is the Lanarkshire district and, to a lesser degree Fife region, were also the areas which suffered the harshest unemployment.

TABLE 3.2 EMPLOYMENT AND MACHINE CUTTING TRENDS, SCOTTISH MINES, 1921-1938.

Region	% fall in Employment	% rise Mines using Coal Cutters
Ayrshire	18	205
Fife	21	16
Lothians	14	69
Lanarkshire	48	10(Fall)
Scotland	36	17

Note Ayrshire district includes Dumfries and Argyll; Fife includes Clackmannan, Kinross and Sutherland; Lothian district includes Mid and East Lothian and Peebles; Lanarkshire includes West Lothian, Stirling, Dumbarton and Renfrew.
Source: Calculated from data in tables 2.3.5 -2.3.10 in chapter 2 and from the Annual Reports of His Majesty's Chief Inspector of Mines, 1921-38.

TABLE 3.3 DISTRIBUTION OF CONVEYORS, SCOTTISH MINES, 1938.

Region	No. face Conveyors	Conveyors elsewhere
Ayrshire	97	41
Fife	272	107
Lothians	62	38
Lanarkshire	352	94

Note Districts comprise of counties outlined in table 3.2
Source: Calculated from data in tables 2.3.5 to 2.3.5 in chapter 2.

It can argued then, that new technology in the form of coal cutting machinery had the effect, as Hay and Latham have argued, of increasing employment opportunities in Scottish mines. The increase in numbers employed for the earlier part of the investigation and the ever increasing use of coal cutters support this hypothesis. After the Great War, however, the growing use of new mining methods had an adverse effect on employment levels. The correlation between declining job opportunities and the spread of mechanical conveyors in Scottish mines had serious repercussions for Scottish colliers. Thus, the impact of new technology on the Scottish coal industry had both benefits and disadvantages for miners. In the initial period employment prospects had been enhanced with the arrival of cutting machines. However, the continued development of new extraction techniques saw the position of Scottish miners under considerable threat. The labour-saving effect of machine mining ultimately resulted in high unemployment in the Scottish coalfields.

Conclusion.

It has been demonstrated that the introduction of new technology in the Scottish mining industry between 1890 and 1939 transformed the work of the Scottish colliers. Modern mining methods resulted in revolutionary changes in the way coal was extracted. These changes impacted profoundly on mineworkers. New working methods in the form of a three shift system were necessary if optimum efficiency was to be realised. This disrupted the social life of miners outside the pit and led to intensification of work when they were mining coal. Hours of work were increased for many in the industry - a phenomena which was directly related to mechanised production. Supervision became more widespread and intensified as the need to meet deadlines became paramount to production efficiency. New processes meant work in mining became physically more burdensome and psychologically stressful due to the speed-up and pacing effect of machinery. New technology had the further effect of reducing the control mineworkers had over production. Mine owners used technology to breakdown traditional and customary practices in the pits and thus erode the power of labour at the point of production. Machine mining reduced the control held by labour because it tended to replace mental labour with manual labour. This resulted in the balance of power over control of production moving in favour of management.

Much debate has taken place on the skill displacing effect of new technology. The conclusions that can be drawn from this study on Scottish mining are as follows. Miners who went on to work coal cutting equipment can be considered as remaining a skilled section of the workforce. This is reflected in the way they were paid and by the views held by some workers in the industry [Lothian coalfield]. That, however, is not to say that specialisation and deskilling did not accompany mechanisation. Indeed, it can be argued that the greatest majority of colliers, those who did not progress to coal cutting machines, ended up being reduced to little more than manual labourers. One factor which influenced specialisation in Scottish mining was the need to adopt the longwall system of extracting coal. By its very nature this technique led to specialisation of tasks underground. The greatest majority of mineworkers at the end of the period could not be classed as superior men in the pit the way their forebears had been at the start of the century.

With regard to the relationship between new technology and employment opportunities the evidence suggests modern mining techniques had both a beneficial and detrimental effect on job prospects for Scottish mineworkers. In the earlier period of the investigation the introduction and diffusion of machine cutters proved a boon to employment prospects. The arguments of Hay and Latham have been validated. Although this was an era when employment opportunities in mining were expanding anyway it has, nevertheless, been proven statistically that regions in the Scottish coalfields which were heavily engaged in mechanised mining were the areas where the greatest job opportunities existed. The evidence from the Fife and Haddington coalfields, in particular, substantiate this assertion. The situation during the inter-war period was drastically different. However, it can be argued that Scottish mining and industry in general was shedding labour during the economic turmoil of the depression years. Still the situation in Scottish districts which had made the biggest strides in introducing mechanical conveyors below ground were also those where unemployment of mineworkers was at its highest. The statistical data for Fife and, especially Lanarkshire confirm this to be the case.

Thus, it has been established that mechanisation of mining operations in Scottish coal mines had profound consequences for Scottish colliers. Work was more intensified as being paced by machine became more common. New technology had the effect of wresting control in the workplace from mineworkers to management. On the whole, the majority of miners were downgraded to semi-skilled operatives or manual labourers and employment opportunities after a period of expansion in the years prior to the Great War were greatly reduced for workers at mechanised pits.

From the foregoing evidence it has been shown that when new technology was introduced into Scottish mines during the 1890-1939 period the outcome for some workers, namely coal cuttermen, was the acquisition of new skills. It is fair to say then, that from the viewpoint of the skill enhancing/deskilling effect of new technology the experience of these mineworkers validates the optimistic model of the impact of new technology on workers, that is, technological change benefits workers by upgrading their skills. On the whole, however, the vast majority of miners witnessed deskilling in the workplace. Furthermore, the fact that colliers experienced loss of control in the pits, intensification of work, and increased threat of unemployment (the effects of these elements, it should not be forgotten, were also felt by coal cuttermen) indicate the negative impact that new technology had on workers in the industry. To this extent at least the pessimistic model retains much of its original validity.

[1] I. Benson and J.Lloyd, *New Technology and Industrial Change*, (1983), pp 61-64.

[2]Benson and Lloyd, *New Technology,* pp 60-61.

[3]J Gennard and S Dunn, 'The Impact of New Technology on the Structure and Organisation of Craft unions in the Printing Industry', *British Journal of Industrial Relations,* [BJIR], (March 1983), pp 30.31.

[4]H Braverman, *Labor and Monopoly Capital: The Degradation of Work in the 20th Century*, New York, (1974), pp 193-195.

[5]A Friedman, *Industry and Labour: Class struggle at Work and Monopoly Capitalism*, (1977), p 46.

[6]D Greasley, 'The Diffusion of Machine Cutting in the British Coal Industry, 1902-1938', *Explorations in Economic History*, Vol 19, 1982, p 249.

[7]*Colliery Guardian*, Vol CXXXVIII, 5 July, 1929, p 27.

[8]National Library of Scotland, [NLS], Lanarkshire Miners' County Union, [LMCU], Executive Minutes, 23 June, 1906, DEP 227.50.

[9]NLS, LMCU, Executive Minutes, 2 August, 1910, DEP 227.53.

[10]NLS, LMCU, Executive Minutes, 16 August, 1913, DEP 227.55.

[11]NLS, National Union of Scottish Mine Workers, [NUSMW], Reports on Annual Conference and Minutes of the Executive Committee, 1933, PDL/45/7, p 18. Also see J Burnett (ED), *Useful Toil, Autobiographies of Working People from the 1820s to the 1920s*, (1994), section by B L Coombes, p 105. Coombes, who was one of the first miners to operate a coal cutting machine in the South Wales coalfield, comments on the number of hours he now had to work. 'For months we worked a double shift each day, crawling on our knees under low height for sixteen busy hours. Several times I went to work on the Sunday morning and returned home late on the Monday afternoon. One week I was in bed only eight hours in all.'

[12]NLS, Fife and Kinross Miners' Association, [FKMA], Board Meeting, 26 May, 1904, DEP 304.1.

[13]A Campbell, 'Colliery Mechanisation and the Lanarkshire Miners', *Society for the Study of Labour History, Bulletin*, [*SSLH*], No. 49, (Autumn 1984), p 38.

[14]Sir R A S Redmayne, *Men, Mines and Memories*, (1942), p 151.

[15]NLS, NUSMW, Reports of Annual Proceedings and Minutes of Executive Committee, No. 542, 1933, PDL/45/7, p 9.

[16]A Barratt Brown, *The Machine and the Worker*, 1934, p 85.

[17]Ibid, pp 85,86.

[18] Glasgow University Archives, [GUA], Lanarkshire Coal Masters' Association, [LCMA], Minute Book, 1913-14, Informal meeting, 19 December, 1913, UDG/159/1/19.

[19] J Melling & A McKinlay, *Management, Labour and Industrial Politics in Europe: the quest for productivity growth during the twentieth century*, (Cheltenham, 1996), p 154.

[20] Ibid, p 150.

[21] I MacDougall, *Mungo Mackay and the Green Table, Newtongrange Miners Remember,* (East Linton, East Lothian, 1995), p141.

[22] Scottish Records Office, [SRO], LMCU, Executive Minutes, 1906, Executive Committee Meeting 6 June, 1906, Dep 227.50.
[23] Melling & McKinlay, *Management, Labour and Industrial Politics, p 157.*
[24] Ibid, p 155 and p171 N 71..
[25]Campbell, *SSLH*, No. 49, (Autumn 1984), p 29.
[26]M A Walter, The Coal Miner this Century: Social and Economic Relationships in the Light of the Changing Labour Process, University of Keele M A thesis, 1982, p 122.
[27]See pp 243-244, for examples of disputes in the Ayrshire coal field which were the result of tighter discipline in the pits.
[28]J H Goldthorpe, 'Technical Organization as a Factor in Supervisor-Worker Conflict,' *British Journal of Sociology*, Vol X, No. 3, 1959, p 219.
[29]Ibid, p 219. This quote was taken from W D Stewart's book, *Mines, Machines and Men*, 1935.
[30]Ibid, p 220.
[31]SRO, Ayrshire Miners' Union, [AMU], Minute Book, 1936-1940, Committee Meeting, 20 September 1939, Dep 258.3.
[32]SRO, LMCU, Executive Minutes 1903-4, Executive Committee Meeting, 28 May 1904, Dep 227.48.
[33]SRO, LMCU, Executive Minutes 1910, Executive Committee Meeting 22 January 1910, Dep 227.53.
[34]SRO, AMU, Minute Book, 1931-1935, Committee Meeting, 4 February 1933, Dep 258.2.
[35] GUA, Lanarkshire Coal Masters' Association, [LCMA], Minute Book 1913-14, District Committee Meeting 5 August 1914, UGD/159/1/9.
[36]C More, *Skill and the English Working Class, 1870-1914*, (1980), pp 60-61.
[37]More, *Skill*, p 61.
[38]I MacDougall, *Mungo Mackay and the Green Table, Newtongrange Miners Remember,* (East Linton, East Lothian, 1995), pp 5-10. Oral account by Archie Wilson of his rights of passage from a pithead coupler to coal cutterman which saw him progress through various pit jobs over a period of 6 years, 1915-21.
[39]See the comments of Kerr, Hyslop, pp 125,127.
[40]More, *Skill*, pp 53-54.
[41]*Coal Industry Commission,* 1919, (B P P),(Sankey), Vol III, (Cmd 361), Appendices, Charts and Indexes, Wage Differentials, Scotland, 1918, p 115.
[42]*Colliery Guardian*, Vol CV, 30 May, 1912, from Mavor's paper *'Underground Conveying*', given to the South Wales Institute of Engineers.
[43]Ibid, Vol CXXXIII, 28 January , 1927, p 200.
[44]Ibid, Vol CXXXI, 5 March , 1926, p 554.
[45]G L Kerr, *Practical Coal Mining,* fifth edition, (1914), p 135.
[46]Kerr, *Practical Coal Mining,* p 172.
[47]SRO, Lochgelly Iron and Coal Company, [LICC], Minute book 1891-1905, Directors' meeting, 15 February , 1905, CB.2/203.
[48]SRO, LICC, Agenda book 1905-1908, Directors' meeting, 16 October, 1907, CB.2/198.

[49]P M Bonsall, 'The Somerset and Lothian Miners, 1919-1947, Changing Attitudes to Pit Work in the Twentieth Century', University of Warwick PhD thesis, 1990, p 91.
[50]Ibid, p 92.
[51]Ibid, p 109.
[52] R Penn & R Simpson, 'The development of skilled work in the British coal mining industry, 1870-1985, Industrial Relations Journal, Vol 17, 4, (1986), p345. Penn and Simpson argue that the new production jobs can all be viewed as enhancing the skill of the craftsman collier. However, whereas this is undoubtedly true of the coal cutterman it is much more difficult to sustain this argument in connection with the subdivided tasks of rippers, packmen and drawers. The tasks of ripping and drawing relied principally on physical strength. The ability to shovel and haul coal.
[53]A Campbell, *SSLH*, No. 49, (Autumn 1984), p 38.
[54]J Hyslop, *Colliery Management*, Second edition, (1876), p 366.
[55]Cited Benson and Lloyd, *New Technology*, p 61.
[56]E H Lorenz, *Economic Decline in Britain: The Shipbuilding Industry, 1980-1970*, (1991), A Reid, 'Employer's Strategies and Craft Production: The British Shipbuilding Industry, 1890-1950,' in S Tolliday & J Zeitlin(eds), *The Power to Manage*, (1991).
[57] Benson and Lloyd, *New Technology*, p 64.
[58] T Cutler, 'The Romance of Labour', *Economy and Society*, Vol 7, No. 1, (February 1978), p83
[59] Sir R A S Redmayne, *Men, Mines and Memories*, (1942), p 151
[60]Walter, thesis, p 180.
[61]*Colliery Guardian*, Vol CV, 6 June, 1913, p 1222. In a paper entitled *Underground Conveying*.
[62]Ibid, Vol CLII, 14 February, 1936, p 312.
[63]F Zweig, *Men in the Pits,* (1948), p 21.
[64]*Colliery Guardian*, Vol CXXII, 9 December, 1921, p 1607.
[65]The technical data on methods of working coal draws heavily on chapter 8 of Kerr's *Practical Coal Mining,* pp 209 - 252.
[66]A R Griffin, *The British Coal Mining Industry: Retrospect and Prospect,* (Stoke on Trent, 1977), p 103.
[67]B Smith, *Seven Steps in the Dark; A Miner's Life*, (Luath Press Ltd., Barr, Ayrshire, 1991), Smith highlights the deskilling nature of mechanised longwall working in his descriptions of the functions of the shotfirer and holeborer, pp 113 and 141.
[68]I MacDougall, (ed,) *Militant Miners,* (Edinburgh, 1981), p 7.
[69]Mitchell Library Glasgow, [MLG], Miners' Federation of Great Britain, [MFGB], Annual Proceedings and Committee Minutes, Annual Conference, 4 October, 1910.
[70]NLS, Mid and East Lothian Miners' Association, [MELMA], Executive Committee Minutes, 28 July, 1900, ACC 4312.6.
[71]NLS, Scottish Miners' Federation, [SMF], Minute Book, 1900-1905, Committee meeting 1 August, 1902, ACC 4312.20.
[72]NLS, LMCU, Executive Minutes, 27 October, 1906, DEP 227.50.

[73]MLG, MFGB, Annual Proceedings and Committee Minutes, Proposition number 4, Annual Conference 4 October, 1910.
[74]*Colliery Guardian*, Vol C, 11 November, 1910, p 956.
[75]Ibid, Vol CIX 29 June, 1915, p 231.
[76]See table 2.3.6, Level of Mechanisation, 1921-1938, Mid and East Lothians and Peebles District, in the appendix.
[77]MacDougall, *Militant Miners*, p 166.
[78]*Colliery Guardian*, Vol CXLVII, 3 November, 1933, p 823.
[79]Ibid, Vol LXXIII, 15 April, 1897, p 733. Latham highlighted these facts in his paper "*Coal Getting by Machinery*", presented to the Nottingham University College in 1897.
[80]Ibid, Vol CIX, 26 February, 1915, pp 439-441.
[81]Ibid, Vol LXXII, 3 July, 1896, p 25.
[82]Ibid, Vol LXXIII, 21 May, 1897, p 961.
[83]*Report of the Miners' Eight Hour Day Committee*, 1907,
(B P P), First Report part III, (Cd 3428), Q1144-Q1155 Evidence of G A Mitchell.
[84]*Colliery Guardian*, Vol LXXXI, 10 May 1901, p 1017.
[85]J Jones, *The Coal Scuttle*, (1936), pp 89-90.
[86]Table 2.3.9, in the appendixp, indicates that the number of face conveyors in Scottish pits increased by 54 percent between 1926-7.
[87]P B Long , 'The Economic and Social History of the Scottish Coal Industry, 1925-1939, with Particular Reference to Industrial Relations', University of Strathclyde PhD thesis, 1978, p 130.
[88]Ibid, p 132.
[89]A J Taylor, 'Labour productivity and Technical Innovation in the British Coal Industry, 1850-1914', *EHR*, Vol XIV, No 1, 1961, p 61.
[90]Annual Reports of the Secretary for Mines, 1921-1938. The data is aggregated for the five counties which presents difficulties when trying to determine the level of mechanisation for each individual county. However, it should be remembered that Lanarkshire was, by far the biggest employer of mineworkers and had a long history of machine mining practice.

CHAPTER 4

Health and Safety in Scottish Pits.

Investigating the health and safety of coalminers presents something of a paradox. Several indicators point to an improvement in mine safety from the mid-nineteenth century. This was undoubtedly the case as any cursory glance at official statistics will confirm. Indeed the death rate of British miners was halved between 1873 and 1938. Several commentators have highlighted the improved safety record in British mines. R A Church and N K Buxton, for instance, both acknowledge the declining death rate, particularly from death as a result of explosion of fire-damp (methane gas) and coal dust. Both authors cite better ventilation and more widespread use of safety lamps as the main factors reducing this type of accident.[1] On the other hand, Margot Heinemann emphasises that the death toll in British mines was still unacceptably high in the early forties:

> The death rate from accident is nine times as high as in the factories. The general accident rate is six times as high as in the factories, twice as high as in the docks, five times as high as in shipping. These are grave figures. They account for the feeling which exists in mining areas that men are permanently in the trenches.[2]

Thus, although conditions in mining improved they were still a long way behind other British industries. Regional variations also existed in death rates throughout the different coalmining districts. The mortality rate in Scotland was traditionally higher than the British average. Yet, while the British national average declined over the 1890-1939 period the death rate for underground workers in Scottish mines was higher at the end of the period than it had been in the 1890s.[3] In analysing this paradox great emphasis will be placed on the impact of mechanisation in Scottish mining, the most mechanised area in Britain for much of this period, to ascertain whether a correlation exists between the adoption of modern mining methods and deteriorating safety levels.

TABLE 4.1 DEATH RATE PER 1000 MINERS BY ACCIDENT, BRITISH MINES, 1873-1938.

1873-1882	2.24
1883-1892	1.81
1893-1902	1.39
1903-1912	1.33
1913-1922	1.15
1923-1932	1.15
1933-1938	1.10

Source: Annual Reports of His Majesty's Chief Inspector of Mines, 1922-38

An investigation of reports by the Mines Inspectorate confirms the number of deaths from accidents in British mines as having steadily declined since the late 19th century. Table 4.1 displays the decennial averages of the death rate per 1000 employees from the early 1870s. It can be seen that the rate of fatalities, except for a hiatus between the 1910s and the early thirties, decreased, albeit somewhat erratically in each period. Taking the long-term view, coal-getting in Britain can be viewed as having become, relatively speaking, a much safer occupation.

TABLE 4.2 DEATH RATE FROM ACCIDENTS PER 1,000 MINERS, U.K & SCOTLAND, 1890-1938.
(Death Rate for underground workers shown in brackets).

Year	U.K.	Scotland
1890	1.89 (2.09)	1.54 (1.62)
1891	1.50 (1.65)	1 58 (1.67)
1892	1.49 (1.65)	1.42 (1.49)
1893	1.55 (1.71)	1.18 (1.23)
1894	1.60 (1.78)	1.27 (1.29)
1895	1.49 (1.64)	1.75 (1.83)
1896	1.48 (1.62)	1.51 (1.49)
1897	1.34 (1.49)	1.60 (1.69)
1898	1.28 (1.37)	1.73 (1.67)
1899	1.26 (1.37)	1.53 (1.58)
1900	1.30 (1.44)	1.47 (1.64)
1901	1.36 (1.46)	1.57 (1.58)
1902	1.24 (1.37)	1.62 (1.73)
1903	1.27 (1.35)	1.60 (1.66)
1904	1.24 (1.34)	1.44 (1.49)
1905	1.35 (1.49)	1.24 (1.54)
1906	1.29 (1.42)	1.38 *
1907	1.32 (1.46)	1.59 (1.68)
1908	1.32 (1.46)	1.60 (1.68)
1909	1.43 (1.61)	1.50 (1.64)
1910	1.69 (1.91)	1.51 (1.65)
1911	1.19 (1.29)	1.40 (1.53)
1912	1.17 (1.25)	1.19 (1.27)
1913	1.55 (1.74)	1.40 (1.47)
1914	1.15 (1.28)	1.09 (1.17)
1915	1.36 (1.55)	1.22 (1.53)
1916	1.32 (1.47)	1.53 (1.63)
1917	1.34 (1.50)	1.34 (1.52)
1918	1.39 (1.61)	1.48 (1.76)
1919	0.94 (1.06)	1.22 (1.41)
1920	0.88 (0.97)	1.10 (1.17)
1921	0.87 (0.98)	0.87 (0.95)
1922	0.95 (1.07)	1.28 (1.51)
1923	1.06 (1.20)	1.36 (1.55)
1924	0.98 (1.11)	1.17 (1.33)
1925	1.02 (1.15)	1.23 (1.43)
1926	1.08 (1.22)	1.10 *
1927	1.09 (1.25)	1.40 (1.65)
1928	1.04 (1.18)	1.33 (1.45)
1929	1.11 (1.29)	1.58 (1.79)
1930	1.07 (1.25)	1.56 (1.88)
1931	0.98 (1.14)	1.45 (1.74)
1932	1.06 (1.24)	1.51 (1.71)
1933	1.03 (1.21)	1.36 (1.51)
1934	1.35 (1.60)	1.38 (1.61)
1935	1.10 (1.27)	1.49 (1.70)
1936	1.02 (1.21)	1.26 (1.46)
1937	1.07 (1.26)	1.22 (1.38)
1938	1.07 (1.25)	1.39 (1.53)

*Information not available.
Source: Inspectors of Mines Reports, 1890-1938.

Table 4.2 shows the death rate for all mineworkers in British and Scottish pits during the period 1890-1938. Figures in brackets portray the death rate for underground workers in both regions. A cursory glance at this data highlights the fact that the mortality rate of Scottish mineworkers throughout this half century was higher than the British average in all but eight years. However, the mining industry has frequently witnessed major disasters, predominantly caused by underground explosions or inruptions of water, as was the case, for example, in the years 1890, 1892-94. Because of such years of unusually high mortality it is difficult to discern the actual trend of deaths from annual figures. By taking decennial averages over the period the effect of major disasters on death rates is counterbalanced and a clearer picture of mortality trends is achieved. These trends are shown in table 4.3.

TABLE 4.3 DEATH RATE PER 1000 MINERS, U.K & SCOTLAND, 1890-1938

	U.K		Scotland	
	Total	U/Ground	Total	U/Ground
1890-1899	1.48	1.63	1.51	1.57
1900-1909	1.31	1.44	1.50	1.63
1910-1919	1.31	1.46	1.34	1.49
1920-1929	1.00	1.14	1.24	1.43
1930-1938	1.08	1.27	1.29	1.61

Source: Inspectors' of Mines Reports, 1890-1938.

It can be seen that a downward trend is apparent in the British average, albeit that a slight increase of 8 deaths per 1000 occurs in the 1930s. A similar trend is noted for underground workers in British pits. The death rate for underground workers, however, starts from a higher base which indicates, as is generally accepted, that work below ground entailed a greater risk of injury. Again an increase is noted in the 1930s. This increase being greater than the rise in the first column indicates that the work of the collier underground was becoming even more hazardous.

At this point a note on the way such statistics were gathered is warranted. It could be argued that better reporting of accidents as the period of study unfolds could skew the results. The Workmen's Compensation Act of 1987 and its amendments may have encouraged better reporting. While this could affect data on non-fatal accidents, it should not influence death-rate figures. The Mines Inspectorate were meticulous in gathering such information, thus the data on fatal accidents would not have been affected by improved reporting methods. However, non-fatal accidents could have been influenced by improved reporting of 'minor' injuries which was necessary if compensation was to be successfully achieved. Yet Leneman's work on the Wemyss Coal Company indicates the extent of reporting of minor injuries despite the fact that many of these failed to qualify for compensation.[4] However, if improved reporting of accidents was a phenomenon of this era this would be true of accidents in mines which used hand-hewing methods and in those where mechanised mining was practised. Thus, it will still be possible to discern trends in injuries between the old and new system of mining.[5]

Figures for those employed in and around Scottish mines also show a reduction for most of the period. The data shows that the risk of accident was greater in Scottish pits and that the decline throughout the period was more erratic and at a slower rate than the British experience. It should be remembered that the high British average during the 1890s was influenced by several major disasters in that decade. When figures for Scottish underground workers are considered it is clear that the risk of being killed was much higher for Scottish miners. The first decade of the twentieth century saw the highest level of accidental deaths, 1.63/000. The following 20 year period witnessed a decline but the risk of death was still much higher in the Scottish coalfields. The 1930s witnessed a sharp rise in mortality rates, indeed, there was a greater chance of underground workers being killed at the end of the period than there had been at the end of the nineteenth century. The statistical evidence, thus, indicates that Scottish mineworkers faced increased risks in the workplace and a greater chance of fatal accidents.

Accidents and the Role of Geology and Inexperience.

The greatest cause of accidents below ground were those which resulted from falls of ground. That is, from collapse of the roof or, as was generally the case, part of the roof or from failure of the supporting walls or sides. This type of accident accounted for 50 percent or more of fatal injuries below ground during this era.[6] Professor J S Haldane, director of the Coal Owners' Mining Research Laboratory, made the following statement about this type of accident:

> Fatal accidents from falls of roof occur only one and two at a time, and hence do not attract the same general attention as explosions and fires, but the classified accident statistics of the Mines Department show that deaths caused by falls of roof in coal mines exceed those caused by all other accidents put together.[7]

This fact was also emphasised in the findings of the Royal Commission on Safety in Coal Mines, 1936, which found that falls of roof and side accounted for 50 percent of all fatal accidents, 42 percent of the more serious non-fatal accidents and 35 percent of all non-fatal accidents. Between 70-80 percent of these occurred at the work-face.[8] This type of accident also occurred more often in Scottish mines. H Walker, the Chief Inspector of Mines, emphasises this in his report for 1930. In that year the death rate per thousand workers from falls was 0.98 in Scotland compared to the British average of 0.69, that is, half as much again. It would appear then that some factor distinctive to coal mining in Scotland must have been present which resulted in increased risks for Scottish colliers. Were geological factors, as Church has argued, the main reason behind regional variations in death rates 'particularly on the incidence of roof falls'?[9]

Probably the most notable geological feature of Scotland's coalfields was that many of the coal seams were badly faulted. This had the effect of 'dividing the underground workings into large numbers of small, isolated and badly shaped districts'[10] which posed added problems for colliers. In some coal mines the seams were inclined at fairly steep angles which created difficulties in getting the coal and also added to production costs. However, conditions varied enormously throughout the Scottish coalfields, and, indeed, could vary greatly within a mine or even a section of a pit. G L Kerr, mining engineer, author and a certified colliery manager who had gained much of his experience and knowledge of the coal industry working in Scotland, commented that at a colliery near Glasgow a seam of coal was much faulted and as a result large areas of coal became very thin. He goes on to note that a second seam, some distance below the first was completely unaffected by faults and maintained its thickness of coal with great regularity throughout the length of the seam.[11] Similarly, the condition of roofs in Scottish pits also varied significantly throughout the country. In some mines these would be thought of as being bad. Or again sections of roofs within a working could be classed as bad. As such they were more susceptible to collapse. Hitches or lypes, that is, dry breaks or fractures within the overlying strata, either occurring naturally or as a result of working the coal, meant the risk of falls was increased. Falls varied in degree, from small pieces of rock liable only to inflict minor damage to large areas weighing several tons which could have disastrous effects for underground workers. An extensive trawl of primary and secondary sources have shown that although Scottish coalfields were widely noted for having deeply faulted seams they were not known to the same degree as being affected with bad roofs. Consequently, as Scotland did not appear to have been unduly burdened by poor roofs any more or any less than other coalfields in Britain it seems unlikely that this type of geological condition could be blamed directly, at any rate, for the higher incidence of underground fatalities in Scotland. This being the case we need to look at other factors.

Several commentators have argued that a major factor behind the growing incidence of accidents in the pits could be attributed to inexperienced workers. The argument centres on two main areas, the employment of young workers and secondly, the employment of workers with no previous knowledge of work in the pits, whether they were of British or foreign origin. Considering, first the role of youth workers in the mines and the argument that inexperience lay behind growing accident rates Heinemann has stated, 'it is well known that the rate of accidents is highest among boys under eighteen, although few of them are employed at the face, the most dangerous part of the pit.'[12] B L Coombes also attributes much of the rise in accidents below ground to inexperienced youth workers. He goes on to argue that the changing work system brought by the move to machine mining was to blame for the increasing incidence of injury among boys. Coombes states:

> The number of boys employed in the mines has decreased of late years but the number of accidents has not decreased...In the old method of mining a boy was working with a man who took an interest in his helper and guarded him carefully until he was experienced enough to fend for himself. In those days there was more time to watch the safety of the boys, as the work was not so rushed and each collier had only one boy to watch. Nowadays, with the three shift method, man and boy have to rely in some measure on timber and other supports that are placed by other men, and sometimes these are hurriedly placed. The spread of machine mining with coal cutters and conveyors has made it a custom for a man to be in charge of more than one boy - and the accident rate is mounting.[13]

Consequently, the pressures brought by machine mining - the need to work a three shift system with the added pressure caused by the pacing of machinery meant that miners now had several youths in their charge and had not the time to teach them thoroughly about safety underground, and hence, injury rates increased.

However, official figures suggest that the rate of injury among young workers was, in fact, considerably lower than the injury rate of older mineworkers. E H Frazer, in his annual report for 1935, acknowledged the argument that a higher incidence of injury was to be encountered among the younger workers in the pits, 'the higher accident rate was due to youthfulness of persons employed on conveyor faces'. He then, however, provided data which destroyed this argument. Frazer noted that detailed records had been kept of 211 persons injured by falls at the coal face and noted that the average age of those injured was 40.2 years. Furthermore, men aged 35-45 accounted for 31.6 percent of all accidents from falls compared with just 9.2 percent for 15-25 year olds. 'These figures, admittedly only a rough indication, do not point to youthful inexperience as a prime factor in accident causation'.[14] Further evidence suggesting that technological changes in the methods of extracting and transporting coal underground influenced safety levels is found when the Scottish accident rate for 1935 is investigated. In that year 250 persons were recorded as having been killed or injured due to falls of roof or sides. (63 fatalities and 187 serious injuries).[15] Of the 156 accidents due to falls of roof 90 occurred at conveyor faces. This was equal to 57.7 percent of the total, but just 52 percent of coal was transported by conveyor, this Frazer argued, 'clearly indicates that workmen employed actually at faces where the conveyor system was adopted were exposed to more risk than [when working] in stoop and room or in hand-filled longwall faces.'[16]

Thus, contrary to the arguments of Coombes and Heinemann, it would seem that young mineworkers had a much better safety record than older miners and, therefore the rising number of injuries cannot be attributed to this group of workers or on their inexperience. Furthermore, it would seem that technological changes in the way coal was produced had adverse effects on workers in Scottish mines.

Turning to the second part of the argument, that workers without previous experience of pitwork were responsible for the increase in accidents, it should be noted that this was an issue which received much attention at the turn of the century. Reference has been made in an earlier chapter[17] to the influx of new workers to the pits often linked to the spread of machine mining. A sizeable proportion of these workers came from abroad, notably from Poland and Lithuania, (generally referred to as Polish in the various source material).[18] Scottish mining unions argued that inexperienced workers, and particularly those of foreign extraction, posed an added risk in the pits because they could not read or understand English and could not, therefore, understand the printed safety regulations. Indeed, a checkweighman from a Lanarkshire mine made this point whilst giving evidence to the parliamentary Commission on Alien Immigration in 1902.[19] The Lanarkshire Coal Masters' Association, on the other hand gave evidence in support of foreign workers. The association argued that the incidence of accidents was in fact lower among foreign workers and they (the owners) had issued safety regulations printed in Polish at their pits.[20] From the available source material it appears that accidents were no more common among this group of workers than they were among Scottish born miners.[21]

A similar situation occurred in mines in the USA in the same period. Whiteside notes that mineworkers in the western states were also protesting against the influx of foreign workers, one commentator stating that:

> aside from poor inspection, the main cause of rising accident and death rates in the nation's coal mines was "the introduction of inexperienced, non-English speaking common labor, represented by emigrants from southern Europe".[22]

Workers in these mines, like their counterparts in Scottish pits were also experiencing the growing switch to mechanised production and the effect this was having on their jobs and their control of work underground. It has been argued that Scottish mineworkers' opposition to the influx of inexperienced workers to the industry can be seen as an attempt by Scottish miners to maintain their control in the pits by fighting to hold on to traditional work methods which were being challenged by the introduction of mechanisation.[23]

The earlier adoption and greater use of mechanised mining methods by coal owners north of the border is one factor which singled out Scottish coalmining in this era. The impact of machine cutting and mechanical conveying and the concomitant changes in working methods may well have had an effect on the safety of workers engaged in 'coal-getting'. This is an area which has received little attention in the literature on British mining. However, James Whiteside's study on coalmining in the western states of America has established that machine mining techniques did increase hazards for mineworkers.[24] The following section will analyse arguments from a wide variety of sources to determine whether the introduction of new cutting and conveying technology in Scottish mining was advantageous to or had adverse repercussions for Scottish mineworkers, thus helping to redress the imbalance in the historiography on British mining.

Mechanisation in Coal Mines, the Advantages and Disadvantages for Mine Safety,

At the end of the nineteenth century it had been recognized that the introduction of machine mining techniques had the potential to enhance the safety of those engaged in the quest for coal. In a paper presented to Nottingham University College Charles Latham[25] whilst, listing the advantages of this new system, noted that mechanical coal cutting not only eased the miner's burden but also reduced the risk of falls of ground. The main danger, he argued, to miners from falls of ground resulted from the slowness by which the coal face advanced when mining by traditional methods. This compelled men to work under the same section of roof day in and day out. A comparison between the rate of advance using machine cutters and hand-hewing methods proved that mechanical extraction advanced the coal face up to five times faster than traditional hewing methods. Machine cutters progressed seven and one half yards in a week compared to one and a half yards by pickmen.[26] Thus the increased speed of work using machine cutters should have reduced the frequency of accidents from falls of ground. Furthermore, undercutting coal by machine, that is, cutting out a thin section of coal at the bottom of the coal seam, also meant colliers were no longer forced to lie under the coal during this operation. Using hand-holing techniques the miner chipped away at the coal at the bottom of the seam until he was working directly beneath the coal often ending up to four, or even six feet underneath the coal. The abolition of this dangerous task in itself should also have reduced the risks of injury for hewers.[27]

It was also argued that the switch to coal-cutting machines would have led to less explosives being used to bring down the coal after it had been undercut.

The mechanised method of undercutting, whereby a groove three to four inches in width is cut at the bottom of the seam and extended two to six feet under the coal made the job of bringing down the coal much easier. The weight of the uncut coal at the front of the groove increased the leverage and the back of the cut acted as a fulcrum which meant the coal was dislodged with far more ease than had been the case with traditional methods.[28] Using this method should have reduced the level of shotfiring and, therefore the amount of explosives which would, presumably, reduce the risk of accidents underground. However, the evidence points to an increased use of explosives. For instance, E H Frazer, the Divisional Inspector for Scotland told the Royal Commission on Safety in 1936, that the amount of explosives per ton of output had risen by twenty percent since 1911 and the number of shots fired per ton had witnessed a seventy percent increase over the same period.[29] The reasons for the increased use of explosives will be looked at below but suffice to say at this stage they were closely connected with speed-up and intensification of work at various times within the industry.

The resort to machine mining techniques should also have reduced the incidence of falls of ground because the new system allowed a greater control of roofs. The system of working using coal-cutters invariably adopted in Scotland was the longwall method of mining. In this system the coalface advanced in a uniform fashion. The length of faces varied but a 100 yard face would have been fairly standard. The coal-cutter was set up parallel to the coalface and usually ran on wheels on steel rails or was hauled along metal skids. To achieve optimum efficiency the machine had to cut to a constant depth along the full length of the face. If faces were irregular the machine would make shallower cuts in places thus reducing the volume of coal to be extracted. Many commentators purport that these straighter coalfaces were a major factor in the reduction of accidents from fall of ground providing, that is, a systematic propping or timbering method was also adopted.[30] A straighter face meant that the weight of the roof was acting along the full length of the undercut coal which would help bring down this coal easier and more safely. Where a coalface was irregular the weight of the roof would be acting in an uneven fashion which could result in partial collapse of the roof. For instance, when working the longwall system by traditional hand methods it was common for some colliers to be further advanced than their fellow workers. This often resulted in partial falls. So by creating a uniform line of advance machine mining methods should have had an ameliorating effect on injury rates.

This new system of mining, to work efficiently required greater and closer supervision. In fact, one of the primary functions of the mine deputy under the new system was to ensure the coal face advanced in a uniform fashion and that roofs were properly supported. Since miners were increasingly grouped in well defined areas (longwall faces) it was easier for the supervisor to control this function than it had been previously when colliers worked in the more widespread and isolated places stoop and room system. One of the benefits of this new system was the need for a more organised method of working underground involving increased supervision and this should have produced a much safer environment for mineworkers.

If coal companies developed well organised and detailed work systems to accompany the introduction of machine technology below ground the outcome, as indicated at one Midlothian colliery, was a dramatic reduction in the frequency of accidents at the coalface. J Masterton, Inspector of Mines for Scotland, noted in his report for 1922, that a new work system had been operating at Newbattle Colliery for some years. A new type of pit-prop was employed - a wood-filled steel tube, which was much stronger than the more common wooden supports. The installation and removal of these supports meticulously followed a carefully thought out plan. The result being that falls of ground at working faces were almost unknown despite some of the workings being 2,500 feet deep. Furthermore, the firm also used steel arches to support the main haulage roads, some of which were 2.5 miles from the main winding shaft. Masterton stressed that since the system was introduced in 1914 there had been just 2 fatal and 2 non-fatal accidents at Newbattle. This seems a remarkable record considering this colliery employed an underground workforce of 1,200. Masterton stated, 'the results speak for themselves, but they have not been arrived at without the proper organisation and rigid discipline necessary'.[31] Consequently, the switch to mechanised mining and the reorganisation of working methods which the system required did, in this instance, significantly enhance the safety of underground workers.

The *Colliery Guardian*, the main journal of the British coal industry, investigated and commented on every conceivable aspect of the coal industry, both national and international. An extensive and intensive search of this publication over the 1890-1939 period has unearthed many technical reports on the impact of machine cutting technology on the industry. Several of these reports provide empirical data which helps support the view that the introduction of machine cutters and conveyors did prove beneficial to the safety of those engaged in the mining industry. For example, L J Barraclough argued that the switch to mechanical means of extraction had improved the safety of underground workers. As the work of the collier was now less demanding and tiresome the miner had more time to pay attention to his own personal safety. Barraclough also contended that the new mining methods reduced the severity of accidents. Injuries were of a more trivial nature. He conducted a survey in the Woodfield seam (the location of this seam/mine was not given) over a period of one year. His findings highlighted the accident rate of machine got coal to be just 50 percent of the rate of hand-hewn coal. Furthermore, the period of disability was much less in the machine sections, on average six days as opposed to twenty days in hand-worked seams.[32]

In a similar vein John Brass, president of the Institute of Mining Engineers, produced evidence which, again, supports the theory that mine safety was improved with the introduction of machine mining. Brass's survey, at an English mine, the Houghton Main Colliery, studied working conditions through three stages of extraction; traditional hand hewing methods, undercut by machine and filled by hand and machine cut and conveyed. He noted that over a one year period the accident rate for face workers employed on mechanised cutting and conveying was 15.5 percent lower than miners engaged in traditional hand cutting. When all workers in the pit were considered accidents fell by 24.5 percent under the new system. Brass also noted an increase in less serious injuries, mainly to the hands and eyes of face workers.[33]

Sir Ewan Williams, president of the Mining Association of Great Britain (MAGB), contended that mechanisation did not increase the total number of accidents and he, too, thought that the severity of accidents was reduced with machine cutting.[34] Table 4.4 is reproduced from his evidence given to the 1936 Royal Commission on Safety. From this data it is clear that the duration of sickness leave lasting longer than two weeks caused through accident at work witnessed a steady decline in the period.

TABLE 4.4 MINERS OFF THROUGH ACCIDENT FOR MORE THAN 2 WEEKS
(Shown as a percentage of total absences.)

1927	70
1928	70
1929	68
1930	67
1931	67
1932	66
1933	65
1934	64
1935	63

Source: Royal Commission on Safety in the Coal Mines, Minutes of evidence, 1936, evidence of Sir Ewan Williams, Q 32150.

It would seem then that the move to mechanised extraction not only reduced the number of accidents in the mines but also reduced the severity of injuries. Furthermore, evidence from the accident books of the Wemyss Coal Company in Fife, which contain detailed information on accidents in this company's pits for the years 1906-1926, indicate "minor" injuries - cuts and bruises - were by far the most common recorded injury.[35] A survey of all accidents recorded at the Earlseat, Rosie and Muiredge mines indicated that minor flesh wounds and knocks to the hands, arms and legs were the most often reported injury. Indeed, only one fatal accident was noted at these three mines during this twenty year period. These findings, therefore, support the arguments of Brass and Williams that a significant number of the injuries were of a trivial nature but the frequency of such injuries increased markedly when mechanisation was introduced.

Thus far, the results of the investigation indicate that both the earlier introduction and the higher level of machine cutting technology practiced in Scottish coalmines, rather than accounting for the high incidence of underground injuries and fatalities, should have significantly reduced the level of accidents in Scottish pits. Other evidence, however, suggests mechanisation did, indeed, increase the dangers faced by Scottish colliers. Before analysing particular case studies to support this assertion some attention will be devoted to the physical dangers presented by the actual machinery and power sources used in machine mining.

New Work Methods - New Dangers?

The first, and probably the most obvious danger was from the machine itself. They were three main type of coal-cutters used in the mines in this era; the disc machine, the chain cutter and the bar machine. All of these posed a danger to the operator and his assistants of being caught by the cutter whilst the machine was in operation. The annual reports of the divisional inspectors are replete with references to machinemen being killed or seriously injured in this manner. For example, of the ten fatal accidents attributed to underground machinery in 1922, all resulted in the death of coal cutting machinemen, six of whom were caught by revolving machinery.[36] Ironically, reference had been made in the previous year's report that some manufacturers, of bar cutters, had adapted the machine so that operators no longer had to work at the 'bar end' of the cutter, that is, they could now perform all operations from the outside of the machine, or the side furthest from the coalface.[37]

Another instance of workers getting caught up in cutting machinery was the case of machineman Joseph Fleming. The accident report book for William Dixon's Govan Colliery, notes that Fleming received flesh wounds from being 'caught by machine'. It was also noted that this accident was not being passed through the insurance books because Fleming was not an employee of the firm. In fact this worker was on loan from the machine manufacturers, presumably demonstrating the machine and/or instructing Govan Colliery workers in machine mining techniques. To be in this position Fleming must have been something of an 'expert' with coal cutters. The fact that a worker of this level of experience could be injured whilst carrying out his tasks is an indication of the level of danger this type of technology brought to the pits.[38]

Of the three types of machines, however, the disc machine was considered the most dangerous to operate. This fact was noted by Frazer in his annual report for 1925, 'as usual the disc cutting machine accounted for more fatal accidents than all other types'.[39] This type of cutter required more power than the other two and was less flexible whilst in operation. A major drawback when using disc cutters was that a recess or 'stable' had to be cut by hand at the start and finish of the cut - to allow the disc access to the face. To by-pass this time consuming job many operators used the machine, set at a sharp angle to the coalface to make the preliminary cuts. The machine being wedged against a pit prop or buttress of coal. These supports sometimes proved insufficient against the power of the machine which often spun round or 'kicked out' catching the machineman or his assistant.[40] Thus, coal cutters posed a very real risk to those involved in the cutting operation. The Lanarkshire miner's agent, R Small noted as early as 1911, 'They [the miners] are always confronted in the bowels of the earth by great risks and dangers, and electric machinery is increasing the danger.'[41]

New technology posed another threat to mineworkers - that of electrocution. Coal cutters were powered either by electricity or compressed air. From the early years of the century Scottish mineowners displayed a marked preference for the more efficient electrically powered machine. Indeed by the early 1920s, 95 percent of machine cut coal from Scottish pits was gained by cutters using this type of power source.[42] Deaths from electrocution are another regular feature in the annual mines inspection reports. For example, in 1922 J Masterton (the divisional inspector for Scotland) indicated the deaths of machinemen at Rosehall Colliery in Lanarkshire and Bowhill Colliery in Fife from electrocution.[43] Three years earlier the then divisional inspector H Walker commented on the death of three machinemen from this cause. He stated, 'there appears to be a want of a thoroughly efficient method of making a sound connection between the framework of coal-cutting machines and the earthing system'.[44]

Table 4.5 records the death toll from electrocution in British pits, there is no comparable data for Scotland, during the years 1921-1937 by class of mineworker. The group that was affected most was that of machinemen and their attendants. 52 of a total of 138 deaths in British pits from electrocution (or 38 percent) were sustained by this group. Again it can be seen that new mining methods and new power sources introduced new dangers for mineworkers.

TABLE 4.5 DEATHS FROM ELECTROCUTION, U.K. COALMINES, 1921-37.

Year	Machinemen & Attendts	Surface Workmen	Electr/icians	Others U/Ground
1921	0	1	1	2
1922	5	1	3	0
1923	4	1	4	3
1924	9	0	2	2
1925	2	2	2	2
1926	2	0	1	0
1927	3	0	3	4
1928	1	1	4	5
1929	6	1	0	3
1930	3	1	1	4
1931	1	0	1	4
1932	1	1	1	1
1933	9	1	1	4
1934	2	1	5	2
1935	0	0	1	3
1936	3	1	1	1
1937	1	1	2	0
TOTAL	52	13	33	40

Note, 1921 & 1926 were years of major strikes.
Source: Electrical Inspector's Report, 1930 p 9, table 4 & 1937 p 8, table 6.

Mineworkers were well aware of the risks posed by this type of power source. For example, R Landless, a former president of the Institute of Mining Engineers, commented at a meeting of the Manchester Geological and Mining Society in 1926:

> it was less than two years ago that a deputation came to him, headed by a miner's agent, with the statement that they had heard electrical coal cutters were going to be installed, and they desired to inform the management that they did not want any needless expense to be incurred because the men would refuse to work with the coal cutters if they were installed. Things were different now and considering the large number of electrical cutters working in this country, and the few, if any, accidents which could be attributed to them, the time had gone by for such a protest.[45]

A point worth mentioning is that when Landless states that things are different now, meaning the use of electricity has resulted in few accidents, the date of this commentary should not be forgotten. That is, Landless was speaking at the end of 1926, shortly after the miners return to work, defeated by the General Strike and subsequent lock-out. So things were, indeed, no doubt different. It would be unlikely that colliers would object so vehemently to new working practices at the end of 1926 as they had a few years previously when the political situation in the pits was radically different. However, getting back to Landless's statement it should be noted that the miners were not against mining machinery *per se* but electrical machine cutters. This difference in attitude to electrical equipment was highlighted some years earlier at a series of conferences held by the Miners' Federation of Great Britain in 1911. At one conference H Smith from Yorkshire stated:

> I want to say in Yorkshire we are not fighting electricity because it is a new thing. We have some experience of it, some loss of life, and we are here to oppose its use... We are fully convinced that electricity ought not to be used in the mines at all. That does not prevent the use of machinery, because you can work coal cutters with compressed air. There may be some men willing to fight electricity for that reason. I have lived long enough to know that it is too late in the day to fight machinery. What we are fighting is for safety. With the use of electricity there is no such thing as safety with one half of one percent inflammable gas [in the air belowground.] We have lost the lives of 85 men and boys from electricity since 1905. With sparking from cables, men electrocuted, and ponies struck dead, we are satisfied in Yorkshire there is no room for safety where electricity is in the pits. We are here to move its total opposition.[46]

The position and attitude of Scottish colliers appears to be somewhat more enlightened as the following comment by James Murdoch, one of the Scottish miners' agents demonstrates:

> This [electricity] is a new force, if we are to be antiquated, if we are to refuse to take the new force that the mind of man has discovered we shall fall behind...The future rests with the nation that can produce its material cheapest and best, and if you do not do this you will fall behind in the race, always having this precaution that everything must be done to protect and save life.[47]

At this conference Yorkshire, Derbyshire and Lancashire representing 200,000 of the 600,000 MFGB membership opposed electricity in any form below ground. Scotland and Yorkshire were the two most highly mechanised coal producing divisions in Britain in this period. What accounted for the difference in attitude to electricity in the pits in these two areas? Once again geological factors come into play. Scottish pits were generally considered as non-gassy at this time whereas Yorkshire mines were susceptible to fire damp, or methane gas. The use of electrical power held obvious dangers for miners working in this dangerous environment. The attitude of the English miners at the 1911 conferences is more understandable and acceptable than their apparent obstructiveness in the mid-twenties. Technology had moved on sufficiently by that time to render the use of electrical power in gassy mines safe, provided the laid down safety procedures were followed. Nevertheless, accidents still occurred due to the use of this power source below ground.

TABLE 4.6 ACCIDENTS FROM ELECTRICITY, BY REGION, 1925-1935 (belowground)

Scotland	206
Northern	178
Yorkshire	71
North Midlands	57
North Western	32
Cardiff	37
Swansea	11
Midland & Southern	40
Total	632

Source: Royal Commission on Safety in Coal Mines, Minutes of Evidence, 1936. From evidence of J A B Horsley OBE, Chief Electrical Inspector of Mines.

Table 4.6 shows the total combined fatal and non-fatal accidents caused by electricity for the years 1925-35. Initially, it would seem that the Scottish and Northern divisions were unduly afflicted with this type of accident. Indeed, Scotland accounted for one third of this class of accident. The reason behind such a high accident is given by J A B Horsley, Chief Electrical Inspector of Mines, 'the preponderance of accidents in the two divisions at the top of the list is to be accounted for by the greater use of coal face machinery, often under difficult conditions in these areas.'[48]

It should also be remembered that practically all of Scotland's machine cut coal was produced by electrically powered machinery by the later date. Still an annual average of 20.6 persons killed or injured from electricity was far from acceptable and considering Horsley's note that most of the injuries stemmed from electric shock suggests that, despite the technological advances in electrical safety, improvements were still very much required.

Electrically driven coal cutters were also the cause of explosions of firedamp or methane gas below ground. It has already been noted that Scottish mines were usually classed as non-gassy. This does not mean that the pits were 100 percent free of fire-damp. In actual fact every mine would have had methane present to some degree but in general the volume of gas was so minute in Scottish pits that it posed no serious threat to safety. Still pockets of fire-damp were to be found in many mines. Normally the mine's ventilation system would be capable of dispersing the gas thus rendering it safe. Scottish pits, due to the high level of machine faces working the longwall system benefited from more efficient ventilation systems. The long, straight coalfaces increased the rate of air flow thus augmenting ventilation.[49] This being the case it seems strange that official reports of the Mines Inspectorate should contain so many reports of accidents from explosions of fire-damp in Scottish mines. Some typical examples include the following.

J Masterton noted that an explosion at Viewpark Colliery in Lanarkshire in 1922 was caused by a switch cover on a coal cutter not being properly secured. Sparking from the electrical contacts when the switch was operated ignited a pocket of firedamp. Eleven miners were injured, two of whom subsequently died.[50] A similar accident occurred at the Shettleston 3/4 colliery in 1930, injuring eight workers.[51] In 1935 an explosion of fire-damp at Carriden Colliery, West Lothian resulted in the death of three machinemen and serious injury to another three mineworkers. These colliers had been working a length of coalface up a 1:6 incline. At the end of the cut, whilst in the process of turning the machine a fall of coal occurred, weighing approximately one ton. The coal landed on the trailing power cable which was drawn taut over the machine. A combination of weight and the sharp edges of the coal crushed the earth and live wire earthing the power cable. The resulting flash ignited the gas. H T Foster, Senior Inspector for the Scottish division, thought a major causal factor was the rapid emission of fire-damp which occurs when the weight of roof comes on a newly cut section.[52] As the speed of excavation had been significantly increased by the move to machine mining this would mean that the frequency of new roofs (capable of emitting methane gas) was also increased and, thus, the risk of explosion was much higher. From these examples, it is clear that the increasingly widespread use of electricity below ground and the accelerated rate of extraction that technological change made possible actually increased the danger of explosion and fire and, hence, had a detrimental effect on safety standards.

Deaths from machinery and electrocution were classified as miscellaneous underground accidents by the inspection authorities. Table 4.7 shows the combined death and injury rate in Scottish mines for the first three decades of the 20th century. The table highlights the trends of the various classifications of accident. It can be seen that all types of accident, with the exception of miscellaneous underground, witnessed a steady decline throughout the era. Miscellaneous accidents are the only group which 'buck the trend'. This appears to be a further indication of the adverse effect that mechanisation, or to be more precise, the actual physical presence of machines and their power source had on mine safety.

TABLE 4.7 COMBINED DEATH/INJURY RATE PER 1,000 EMPLOYEES, SCOTTISH MINES, 1900-1929.

Site of Accident	1900-09	1910-19	1920-29
Underground			
Explosion F/Damp	1.13	0.79	0.66
Falls of Ground	3.80	3.11	2.70
Shaft	0.50	0.30	0.24
Haulage	1.67	1.53	1.26
Misc Underground	1.24	1.43	1.80
Total Underground	8.34	7.16	6.66
Surface	5.19	4.27	3.34
Grand Total	7.76	6.58	5.95

Source: Inspectors of Mines Reports, 1930, p 14.
N.B Data for 1926 excluded from 1920-1929 period.

Table 4.7 reinforces the point made earlier that falls of ground were the greatest single cause of fatalities and injuries in the mining industry. Mechanisation, as stated earlier, should have reduced this type of accident owing to the increased speed that the coal face could now advance. Data in the table seems to support this, that is, the death/injury rate per 1,000 miners from falls of ground declined from 3.8 to 2.7 during the first three decades of the century. Closer inspection of the data, however, reveals that the frequency of this type of accident, and of those classed under haulage, were declining at a slower rate than other accidents underground. The accident rate caused by falls in the twenties was only 71 percent of its 1900-1909 level. (The corresponding figure for haulage accidents being 75 percent of its earlier level). The rate for accidents classed under explosions of fire-damp and shafts were just 58 and 48 percent of their earlier level. It is significant that technological change to mining operations in the form of coal cutters and conveyors made their greatest impact on work at the coal face and haulage operations - locations where the risk of injury was greatest. Mechanisation, it can be argued was detrimental to the safety of pitworkers.

J Masterton thought one reason for the, high incidence of injury caused by falls of ground lay in the method of supporting roofs as his report for 1921 indicates:

> One would think that in a division where there is so much coal cutting, (by machine) which places the men under fresh roofs everyday, the accident rate should be smaller. I am convinced that it would be if "strapping" could be insisted on along the whole line of the face of every seam in every mine, but, unless that were made compulsory all over Britain, it could not be done in this Division alone without putting owners and workmen at a disadvantage in the market.[53]

Cutting by machine meant a greater area of roof was left unsupported adjacent to the face - more space being needed to accommodate the machine than when cutting by hand. Thus the traditional method of support, single props, was no longer suitable or safe. The introduction of new technology to mining also necessitated a re-organisation of working methods. This point was emphasised again in the inspection report of 1922. In this instance Masterton notes that a well organised and properly laid out system for machine mining would not only increase safety levels but also prove more efficient. Longwall faces in pits, where little thought was given to the organisation of work, which started out in a straight line tended to end up semi-circular. This meant that the natural weight of the roof, the forces of which bearing on the undercut coal eased the work of the strippers, was lost and, therefore, more use had to be made of explosives to bring down the coal. It would seem that the much praised system in operation at Newbattle Colliery in Mid-Lothian was the exception rather than the rule. Thus, the introduction of modern cutting technology, if not accompanied by a complete reorganisation of underground working procedures, increased the risk of accident.[54]

Masterton was also concerned that the change to machine mining resulted in added risks to miners because new methods meant many traditional mining practices were no longer followed or were not carried out to the same extent. The building of pack walls whilst coal-getting being a case in point. Masterton thought that 'the lack of adequate packs were the cause of many of the accidents which have to be classed as unavoidable'.[55]

A pack wall was a principal permanent support, constructed of stone which provided a substantial form of roof support. The stone used in their construction was produced when roads were cut through the mine workings. Building pack walls, moreover, not only enhanced safety in the mine but also removed the need to transport waste material to the surface. When working the stoop and room system many roads were cut, perhaps one every 20 to 40 yards, thus there was always a ready supply of building material for packs. As working faces were longer in longwall mining fewer roads were required. Therefore, less stone was available for support walls.[56] The introduction of conveyors to mechanised longwall faces compounded the problem. Where coal on machine-cut faces was hand-filled more roads were cut to reduce the distance and time fillers spent transporting hutches to the main haulage roads. The introduction of conveyors which carried the coal to the end of the face reduced the need for multiple roads and thus further reduced the supply of pack building material. This fact was noted by Frazer in 1935:

> In eighty longwall faces where coal was hand-filled there was 58.1 yards of packing per 100 yards of face. In 112 conveyor faces sampled the amount of packing per 100 yards of face was just 41 yards. As packs help greatly to control the rate of settlement, and good packing reduces the amount of roof bending and number of fractures in advance of the coal face, it seems feasible that fewer packs may increase the liability to small falls of roof, even where the packs are sufficient to prevent total collapse.[57]

The adoption of new technology in mining was not limited to new forms of cutting and transporting coal but also brought about far reaching reorganisation of traditional work methods some of which, as the example of pack walls indicates, increased the risks faced by mineworkers in Scottish pits.

Mechanisation created other hazards for mineworkers, including machine vibration and noise. The noise from machinery meant that the miner found it much more difficult to tell if roof falls were likely by listening to the sounds of the roof or to the differences in sounds made when he tested them by tapping his pick against them. One miner has described 'roof squeeze' or the weight coming on a roof and how the effect this had on pit-props alerted the men to imminent danger:

> Crack, Crack, it was a good imitation of desultory rifle fire, but we knew that when it developed into the continual crack-crack of machine gun firing it would be time to retreat at top speed, for the weight would be crushing everything under it.[58]

The move to mechanised production methods changed all that. Noise and vibration generated by machine cutters altered working conditions so much that colliers were denied this advanced warning system, indeed pit-props and roofs could be collapsing around them without their knowing until it was too late. An American mineworker working in a machine section in a Colorado pit recalled:

> when them damn machines are in there growling and smoking and belching...you can be working there running the machine and something behind caving to beat hell and you don't know it till its too late.[59]

The following more detailed account shows that the conditions and dangers were the same for miners in this country. This mineworker also highlights some of the other problems faced by machinemen:

I can hear the thud and shaking of a coal cutting machine as I pass over a section of roadway. This machine is at work in a small seam that is about thirty feet of solid ground below us, but it shakes the ground where we are passing and affects the roof. I worked as a driver of one of these machines for some years. They do away with the old method of holing with a mandrel [type of pick] under the coal until one had cut deep enough to allow the coal to part from the roof and fall down. This was deadly monotonous work, for we had to lie on our sides and chip-chip at the bottom of the seam until we had loosened enough coal for the day. A coal cutting machine will do as much work in ten minutes as we did in a hard day. I helped to fit up the first chain machine that was used in this area, and I was trained by the demonstrator to drive it. The machine weighed over three tons, was about ten feet long, and was driven by electricity equal to forty horse-power. It moved along the coal face at about a yard a minute when cutting, and undercut the coal to a depth of five feet. It was a good invention if it had been used right, and it might be of benefit to the men and the owners. The noise of the machine working prevents the men from hearing the roof cracking and weakening. As about three feet of width must be left clear to allow the machine to travel, and the resulting cut is five feet, it can be seen that nearly eight feet of roof must be left without any strong support, for a while at any rate. The vibration of the cutter shakes down any loose stones that are near the coal face, I have known the noise to be so loud that a post [pit-prop] has snapped in half near my elbow without me hearing it - and I have exceptionally keen hearing. In time the work on the machines affects the nerves of the men that do it, and the noise affects their hearing as well as the dust harming their chests. This cutting should be done carefully and steadily but the usual method is to rush for the extra ton of coal.[60]

The diffusion of face conveyors further increased the dangers for underground workers. These machines increased noise, vibration and dust in the pits. Bob Smith, speaking about mining in Ferniegair Colliery, Lanarkshire, in the 1930s underlined this fact when he described his first experience of 'Pan Run Conveyors' - a type of shaker conveyor:

They were troughs, each about seven foot long, mounted on rollers and overlapping. They were set on a slope along the length of the face, and were shaken back and forth lengthwise by the Pan engine. That made the coal travel down their length, and at the end it was loaded into hutches. It was a deafening operation and very dusty. None of the men liked it, even if it did make the work somewhat easier. We had been used to the comparative quietness of working only with pick and shovel, so that we could hear the movement and creaking of the roof. We felt a lot safer when the place was quiet enough for that, because we judged the condition of the roof and sides by the sounds they made. In the deafening din of the Pan Run, you could hear nothing else but the incessant roar of machinery, and felt very defenceless.[61]

The addition of conveyors to machine mining increased hazards in two ways. Vibration could weaken or bring down roofs that were already in a weakened state. Secondly, conveyors were laid out parallel to cutting machines on the side furthest from the coal face, thus increasing the area of roof which required to be supported. Frazer, noted a correlation between the increase in the use of conveyors and the rise in deaths from falls. These increased from 0.94 in 1924 to 1.27 in 1935. (per 100,000 manshifts worked.) 'It is significant that the increase in the rate synchronizes with an increase in the number of conveyor faces'.[62] This increase, it should be noted, was due to a rise in accidents at the working faces alone not to falls elsewhere in the pits.

The wider adoption of conveyors at the coalface also changed work systems. Before their introduction the miners would load the coal they had brought down into tubs or hutches. These would then be transported along the face to the access and haulage roads. When engaged in this part of the work cycle the colliers were no longer under the new roof at the face. As this was the most hazardous place in the pit any time spent in other areas must have reduced the risk of accident for the mineworker. The move to intensive mining methods meant miners were working in the most dangerous places for practically their whole time below ground. J.Jones of the MFGB in his evidence to the Royal Commission on Safety stated that the time spent in transporting coal to the roadways used to account for 17 percent of a miners time during a shift.[63] Therefore, the changes to working methods brought by the conveyor significantly increased the risks for coalminers. It should not go unnoticed that the four districts in Britain with the highest rates of accidents from falls were also the divisions which had adopted mechanical conveyors to the greatest degree, these being Scotland, Yorkshire, Northern and South Wales.[64]

J Jones noted that the chief characteristic of machine mining 'was its intensity, the whole cycle of operations being designed to work at speed and with the minimum of interruption'.[65] The effect that the increased pace of work had on mineworkers was highlighted very effectively in the words of the haulage worker quoted in chapter 3. His reference to working constantly at top speed as he tried to transfer coal from hutches which, 'were vomitting more than he could clean up' into those at the shaft bottom which, 'had larger mouths than he could fill'[66] conveys the pressures and intensification of work that miners faced when pitwork became mechanised. The faster pace of work would have had an impact on the safety of pitmen. Frazer stated that working on the conveyor system there was more rush and bustle than when working with traditional holing methods.[67] The increased pace of work was undoubtedly part of the equation linking the rise of accidents to the greater use of conveyors underground noted by Frazer above.[68]

Safety in Scottish Pits, an Inter-County Comparison and the Experience of the Wemyss Coal Company, Fife.

That machine cutting and underground conveyance practices introduced new dangers for colliers was remarked upon by R McLaren, Inspector for Mines, East Scottish Division, in the early 1900s. In 1906 he noted 'accidents in the district had increased by 33 percent on the previous years whilst numbers employed had only risen by 3 percent'. McLaren attributed this rise to mechanisation, 'a new class of accident has now to be reckoned with, namely, coal cutting machines, no less than five fatal accidents happening in connection with their working.'[69]

Deaths from accidents in the district had increased to 86 which was 21 higher than the total for 1905. 56 of these were in the counties of Edinburgh and Fife. This was equivalent to 65 percent of total fatalities in the eastern division, which was out of proportion to the numbers employed and output produced by mines in the Edinburgh and Fifeshire fields. These fields employed half of the miners in the eastern division and accounted for 49 percent of the total output.[70] Thus a significant difference existed between the level of underground fatalities and employment and output levels.

The Edinburgh and Fife coalfields were the most highly mechanised areas of the eastern Scottish division in 1906. Twenty seven mines were engaged in machine mining out of a total of 69 in the county.[71] This lends credence to McLaren's view that mechanisation was a fundamental factor behind the rising death toll in the pits. Table 4.3 shows the years 1900-1909 as having the highest death rate for underground workers in Scottish mines. It was also during this decade that many companies first employed coal cutters at the face, for example, the Lochgelly Iron and Coal Company Limited.[72] This further suggests that the move to machine cutting had adverse effects on safety standards below ground. However, detailed investigation of the relationship between the adoption of machine mining techniques and rising mortality rates is required to ascertain whether a correlation exists between these variables.

One way of establishing this would be to show that death rates were higher not just in the most mechanised counties but in the actual mines were coal cutters were at work. Fortunately McLaren appears to have been more meticulous than all the other divisional inspectors during this era. He was the only inspector who detailed, in the annual List of Mines, which mines within his region used coal cutters. Also the annual inspection reports up to 1914 give details of all fatal accidents in the mines - name of mine, name and occupation of deceased, site and cause of accident. By cross referencing this information with that in the List of Mines which gives numbers employed, above and below ground, it is possible to achieve the death rate per 1000 miners for a given county, thereby permitting a comparison to be made between the county average and the death rate for mines engaged in machine mining. This information is shown in table 4.8.

The data clearly shows that the fatal accident rate in mines using machine coal cutters was significantly higher than in those which depended on traditional hand hewing methods. Consequently, it seems that McLaren was correct. Machine mining was a more dangerous method of coal getting. It did lead to an increase, not a reduction, in deaths in the pits.

TABLE 4.8 ACCIDENT DEATH RATES (PER 1,000) IN MECHANISED MINES, EASTERN SCOTTISH COUNTIES, 1906.

County	All Workers	County Average	U/Ground Workers	County Average
Edinburgh	2.54	1.86	2.60	1.59
Fifeshire	2.80	1.94	2.83	2.05
Haddington	1.74	1.67	2.13	2.08
Lanarkshire*	1.19	0.74	1.09	0.73
Linlithgow	2.73	1.35	3.26	1.66
Stirling*	0.92	0.59	1.17	0.75
Scottish Average	1.99	1.36	2.18	1.47

*Figures for Lanarkshire and Stirling are for the eastern sections of these fields only. No mines were recorded as using coal cutters in the Clackmannan coal field therefore this district has been omitted from the table.
Sources: Annual Reports of His Majesty's Chief Inspector of Mines, 1906 and the annual List of Mines, 1906.

This of course is just a snapshot of the situation in 1906 and while of value it could be argued that it is unrepresentative of other periods. The detailed data on accidents in the inspector's reports is less informative after 1914. So comparisons after the date are fraught with difficulties. Another complication is that a full run of the annual Lists of Mines has not been traced, thus it is difficult to obtain data on the numbers employed in any individual mine except for certain years. However, both these sources exist for the year 1914 which will allow a comparison to be made, albeit over quite a short time span.

When the Scottish average death rate for all mineworkers is considered the data indicates that there is no difference between workers at pits using machine technology and those which still relied on traditional hand-cutting methods.

TABLE 4.9 ACCIDENT DEATH RATES (PER 1,000) IN MECHANISED MINES; SCOTTISH COUNTIES, 1914.

County	All Workers	County Average	U/Ground Workers	County Average
Ayrshire	0.74	0.86	0.70	0.80
Clackmannan	1.18	0.84	2.04	1.12
Edinburgh	1.52	1.93	1.72	2.08
Fifeshire	0.85	0.82	0.93	0.87
Haddington	1.35	1.16	1.28	1.09
Lanarkshire*	0.98	1.08	1.09	1.23
Linlithgow	0.60	0.70	0.76	0.86
Stirling*	1.64	1.43	1.46	1.09
Scottish Average	1.10	1.10	1.25	1.14

*Figures for Lanarkshire and Stirling are now for the entire county.
Sources:Annual Reports of His Majesty's Chief Inspector of Mines, 1914 and the annual List of Mines, 1914.

As can be seen in table 4.9 the Scottish average death rate for all mineworkers indicates that there is no difference between workers at mechanised pits and those which still relied on hand-cutting methods. When underground workers are considered, however, the Scottish average shows that it was more dangerous to work in mechanised mines. Comparing the data in both tables it can be seen that safety standards improved in all areas with the exception of Stirling. In this county the death rate for all workers increased from 0.92/000 in the earlier period to 1.64/000 in 1914 and the rate for underground workers rose from 1.17/000 in 1906 to 1.46/000 at the later date. The data also reveals that an improvement had taken place in mechanised mines which had a high death rate in 1906. That is, at mines in Edinburgh, Linlithgow and Lanarkshire. Fifeshire mines had also undergone a similar improvement but it was still slightly more dangerous to work at pits engaged in machine cutting in 1914. Clackmannan district, which was not included in the first study because all mines used traditional hand-cutting methods at that date, exhibits a significant difference in death rates between pits using machine technology and traditional methods. This field was in the early transitional stage of modernisation. It could be argued, taking on board the somewhat limited value of a comparison over such a short period, that the introduction of new cutting methods witnessed an initial period of high accidents whilst workers became accustomed to the machines and changed work practices. After this learning period safety improved in the mines.

Just such a point was raised by the Royal Commission on Safety, 1938, and it was stated by H J Humphrys from the Yorkshire area that accidents were high until people got accustomed to the new ways.[73] In giving his evidence J R Felton, from the North-Midlands division, pointed out that the death rate in his district for the period 1930-1934 was 1.53/000, whereas the Scottish figure for these years was 1.15/000. This he ascribed to the rapid transition to mechanised mining. In 1930, 35 percent of the North-Midlands output was cut by machine and 16 percent conveyed. These percentages had increased to 60 percent and 50 percent by 1934. The evidence strongly indicates that the unfamiliarity of machine technology was a significant factor behind the high mortality rates.

The length of the miner's working day, which also influenced injury rates, was legally altered several times during the period under investigation. For instance, hours were cut to eight by Act of Parliament in 1909. The standard shift was further reduced in 1919 to seven hours. It should be noted that this was the time miners spent getting coal. It did not include time taken to descend or ascend the shaft, nor time taken to travel to the face underground which often added an hour to the miner's day. It would be reasonable to assume these reductions in hours should have proved beneficial to mine safety. Less time spent at the gruelling task of 'winning' coal should have meant mineworkers were less tired and, thus less likely to make mistakes which could result in injury.

However, one finding of the Miner's Eight Hour Day Committee was:

> we have failed to obtain any evidence which would associate the numbers of accidents in any disproportionate degree with the hours in excess of eight spent underground by the men, or with the districts in which the longest hours are worked.[74]

In other words accident rates were not reduced as shift lengths were cut. On the face of it this seems a bit surprising. Arguably, one might expect accidents to increase when workers became fatigued and less alert to the dangers which surrounded them. However, most experts who gave evidence to the committee seemed to agree that the opposite would happen. That is, a shorter working day would result in a deterioration in pit safety. Henry Mungall, chairman of United Collieries, for example, stated in evidence to the Miner's Eight Hour Day Committee that he was of the opinion that the reduction in working hours for miners would not be conducive to safety underground.[75] This was also the opinion of many other Scottish coalowners. A Bowman, of the Rothes Colliery in Fife, when questioned on the implications for mine safety of the reduction of the working day to eight hours gave the following statement:

> Yes, I think it would tend to increase them [accidents] very much, because hurry in a mine should not be allowed. You have more need to pass a Bill to stop hurry than increase it. There is nothing worse in a mine than hurry-burry, and there is sure to be forgetfulness, and if so catastrophes occur... I do not think anything worse could happen at a colliery than a law saying you must quick work.[76]

J Strain, chairman of John Watson Ltd., also argued a reduction in the working day would tend to increase the danger in the mines by 'inducing more hurrying and hustling all round'.[77] G A Mitchell, of Kerr and Mitchell, concurred with his fellow Scottish coalowners. In his judgement:

> the number of accidents would be increased with a legal limitation of hours. Men would be working under greater pressure and would be inclined to take risks at the working faces which they would not take at present. There would be a temptation on the part of management to risk postponing repairs in roadways, which under present conditions can be affected by the working of overtime where necessary.[78]

It was generally felt among coalowners that reducing the length of the working shift to eight hours would result in mineworkers attempting to produce the same output that they had attained in nine hours. In trying to match their former production quotas some miners may have been tempted to cut corners and take risks they would not normally have taken. J S Dixon of the Bent Colliery Company Ltd., and Jas Dunlop and Company Ltd., (and a founding member of the Lanarkshire Coal Masters' Association) stressed his greatest fear was that colliers would be careless about propping their places properly and this would result in more accidents at the coalfaces.[79]

D Mowat, of the Summerlee Iron and Coal Company, had noted in 1912 that the accident level in Scottish mines during the years 1902-1907 had been the lowest in history. Since then, however, there had been an increase in accidents due, Mowat argued, to the hustle and bustle caused by the Eight Hour Act.[80] Reference to the data in table 4.2 indicates that Mowat could not have been talking exclusively about death rates. The average death rate, for all underground workers, in Scottish pits for 1902-1907 was 1.62/000 which was identical for the years 1908-1911, (1911 would have been the latest figures available to Mowat in June 1912). The figures for all mineworkers was 1.48/000 for the earlier years and 1.50/000 for the later period. This did constitute a rise in mortality rates but the increase was minimal. He may have been referring to the overall accident rate. Although this rate witnessed a steady decrease, as can be seen from table 4.7, it is still possible that fluctuations occurred. It is possible that he was voicing his personal opinion based on his experience of his own company, which in 1912 employed in excess of 5,000 workers.

Table 4.10 was compiled from data found in the accidents books of the Wemyss Coal Company. This source contains every reported accident which happened at each of the Wemyss Coal Company's mines during the years 1907 to 1926. Analysis of this data should determine whether a relationship existed between mining accidents and the introduction of mechanical mining techniques. The sample investigated accidents at three of the Wemyss Coal Company's mines, Earlseat, Rosie and Muiredge. In 1906 these pits employed 412, 375, and 439 miners respectively.[81] Thus, the mines in the sample are typical of the average Scottish pit in terms of size by labour force.[82] As far as can be determined from official sources, the annual List of Mines and the yearly Inspectors' of Mines Reports, the Earlseat mine was using coal cutters throughout the years in question. The Rosie pit was worked by traditional hand methods in 1906 but the List of Mines reveals that cutting machines had been introduced between that year and 1912. The available List of Mines data shows the Muiredge mine as being worked by traditional hand-hewing methods between 1906 and 1920. However, it is known from other sources that Muiredge was still exclusively working by hand until 1922.[83] Consequently, three mines at various stages of transition to machine mining have been examined to ascertain whether mine work was safer when traditional methods of extraction were used or whether modern work practices enhanced safety below ground.

The investigation concentrates on the years 1907-1914 because figures for the war year can be held to be unreliable. That is, they do not reflect a true picture of health and safety in the pits because much of the work force was new to the work - replacing miners who had volunteered to fight in the war. This would have distorted accident rates in the mines. This study should also show whether the actual transition stage proved to be more dangerous for colliers as the data in tables 4.8 and 4.9 indicates.

TABLE 4.10 ACCIDENT FIGURES, WEMYSS COAL COMPANY, MUIREDGE, EARLSEAT AND ROSIE MINES, 1907 to 1914 (accidents per 1,000 miners in brackets)

Year	Muiredge (Hand-hewing)	Earlseat (Mechanised)	Rosie (Mech^D c.1906/12)
1907	52 (114)	53 (113)	42 (98)
1908	47 (100)	66 (126)	56 (116)
1909	60 (123)	83 (144)	97 (180)
1910	56 (112)	94 (148)	100 (168)
1911	62 (119)	113 (164)	86 (133)
1912	66 (127)	78 (105)	97 (138)
1913	75 (148)	87 (121)	133 (181)
1914	50 (105)	65 (93)	90 (118)
1907-14 Ave	(119)	(127)	(156)

Source: Wemyss Coal Company, Accident Books 1906-1926, SRO,(WRH), RH.4/142/449, 450 AND 451.

Due to lack of annual data on the numbers employed at these mines the value of table 4.10 is somewhat diminished. That is, it has been impossible to compile accidents per thousand employees on an annual basis. This is important because the size of the work force can obviously influence accident rates. For example, 42 accidents were reported at the Rosie Colliery in 1907, and 97 just two years later. If the work force remained constant then the accident rate would have more than doubled in these years. However, if the mine had increased the numbers employed by more than doubling the labour force then the accident rate would have remained constant. (In fact, in this instance the accident rate did, indeed, double at this pit). Still the employment figures are known for several years during the period, these being; 1906, 1912, and 1914. This information has been used to extrapolate the accident rate for the remaining years. While, obviously not an ideal situation, the resulting data does allow comparisons to be made and trends in underground safety to be determined.

With regard to the argument that mechanised mines were more dangerous to work than those where traditional cutting methods were employed the following conclusions can be drawn. The data indicates that accidents were, indeed, less frequent at Muiredge where traditional hand-hewing of coal was practised. The average injury rate for this eight year period being 119 per 1,000. The mechanised Earlseat mine had a higher injury rate - 129 per 1,000 on average met with an accident at this mine. The sample indicates, therefore, that it was, indeed, more dangerous to work in pits where machine mining was the mode of production. However, injuries were much more frequent at the Rosie mine where the average over the period of this sample was 156 per 1,000. This mine changed from hand to machine mining sometime between 1906-1912. This supports the theory (as the evidence in tables 4.8 and 4.9 indicated) that mineworkers faced the greatest risk of injury when a pit was in the transition stage - changing from hand to machine cutting techniques. Further evidence of this can be seen in the accident figure for the Muiredge pit for 1921-23. Injury rates at this mine increased four fold during this time when it is known that cutting methods changed from hand to machine.[84] However, as mines were adopting machine technology at different times it is very possible that Scottish mineworkers experienced these periods of high risk frequently throughout the era as fields, mines, and sections of mines switched to machine cutting and conveying of coal.[85] From this evidence it can be said that the adoption of new cutting technology did have a detrimental effect on the health and safety of Scottish miners.

Conclusion.

This study of the interaction between mechanisation and health and safety in Scottish mines has shed light on several areas and allows the following conclusions to be drawn. Although aggregate figures show an improvement in safety in mines the situation in Scottish pits was adversely affected by the move to machine mining. Several arguments which saw mechanisation as having an ameliorating influence on mine safety have been analysed. Mechanisation was thought to have improved safety conditions for mineworkers because the increased speed of working would have reduced the time spent at the coal face which was the most dangerous place in the pit. Machine mining should also have reduced the use of explosives, eased the burden on mineworkers and, through the need for more supervision, further improved safety below ground. Evidence has been produced to show this was not the case. For example, the use of explosives increased in Scottish pits in this era. Indeed, the Royal Commission on Safety, 1938, found that mechanisation of coal production resulted in an increase in the number of shots fired per ton of coal mined.[86] The use of machines at the coal face altered traditional work systems to the detriment of safety in that as the new system requires a greater area of roof to be left unsupported the risk of falls of roof and sides was increased. This danger was multiplied with the growing use of face conveyors in Scottish mines. The decline in the use of pack walls posed similar dangers to colliers. The machines and their power sources also introduced new hazards into the mines. Statistical data reveals that machinemen and their attendants faced a much higher risk of injury than any other group of workers in the pits. Much of this was due to the greater reliance on electricity as a power source in Scottish mines. Furthermore, the Royal Commission also found that delays caused by mechanical breakdown or electrical failure also impinged on accident rates. These increased due to the hustle and bustle engendered as miners tried to make up for lost production when repairs were effected.[87] Increased noise and vibration which accompanied machine mining posed additional hazards as did the intensification of work which new cutting technology brought with it.

The micro-study of the three mines belonging to the Wemyss Coal Company has shown quite clearly that Scottish miners faced greater hazards when engaged in machine mining of coal than they had when winning coal by traditional hand-holing techniques, as the data for the Muiredge and Earlseat mines prove. However, the highest rate of accidents occurred at the Rosie pit which had switched to machine cutting a few years after the period of investigation commenced. The evidence clearly indicates that the transition stage between hand and machine cutting posed the biggest threat to Scottish colliers. Once more the Royal Commission recognised the initial stage of mechanisation as one of great danger for mineworkers:

> the want of adjustment to new conditions during the transitional period has had a considerable influence in recent years and that there should be a gain on balance when the new methods have become more familiar.[88]

The implication being that the move to mechanised mining, after an initial period of higher than normal accident rates, would ultimately prove beneficial to mine safety. Evidence in tables 4.8 to 4.10 support this assumption. Yet, accident rate statistics for Scottish miners emphatically deny this to be the case. Work was more dangerous in Scottish pits at the end of the period of than it had been in the 1890s. Quite an enigma. The author would argue, however, that the piece-meal way new technology was adopted throughout Scotland's coal mining districts, and indeed, within firms, mines and sections of mines, meant Scottish colliers continually faced these new hazards as pits gradually modernised methods of coal extraction. This fact, and the bulk of the foregoing evidence points to mechanised production methods as having a decidedly detrimental effect on the health and safety of Scottish miners.

Notes for Chapter 4.

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[1]N K Buxton, *The Economic Development of the British Coal Industry*, (1978), pp 139,140. R A Church, *The History of the British Coalmining Industry, Vol 3, 1830-1913: Victorian Pre-eminence,* (Oxford, 1986), pp 582,583.
[2]M Heinemann, *Britain's Coal: A Case Study of Mining crisis*, (1944), p 65.
[3]See table 4.3 p 155.
[4]L Leneman, 'Workmen's Compensation at the Wemyss Coal Company, 1906-1924', *Scottish Economic and Social History*, Vol 13, (1993). pp 43-56.
[5]See pp 230-233 for a more detailed investigation of accident trends in three of the Wemyss Coal Company's mines.
[6]Inspector of Mines Reports 1890-1920, and Annual Report His Majesty's Chief Inspectors of Mines,[ARHMCIM], 1921-1938.
[7]Mining Association of Great Britain (MAGB), *Historical Review of Coal Mining,* (1924). Chapter XVIII, Health and Safety in British Coal Mines by Professor J S Haldane, Director of the Coal Owners Mining Research Laboratory at Birmingham University.
[8]*Royal Commission on Safety in Coal Mines,* Minutes of Evidence, 1936, para 69.
[9]Church, *History*, p 588.
[10]*Royal Commission on Safety in Coal Mines*, Minutes of Evidence, 1936, para 3.
[11]G L Kerr, *Practical Coal Mining*, (1914), fifth edition, p 4.
[12]Heinemann, *Britain's Coal*, pp 70-71.
[13]Coombes, *I am a Miner*, (1939), pp 65-66.
[14]Inspector of Mines Report, 1935, Scottish Division, pp 49-50.
[15]Ibid, p 18.
[16]Ibid, p 20.
[17]See chapter 3, p 131-132.
[18]Glasgow University Archives[GUA], Lanarkshire Coal Masters' Association, minutes executive meeting, 29 April, 1903. Reference made to Graighead and Bothwell Collieries where 30 percent of underground were Polish.
[19]Ibid, executive meeting, 25 March, 1903.
[20]*Colliery Guardian*, Vol LXXXIII, 11 April, 1902, p 785.
[21]Inspector of Mines reports during this period gave detailed information on all fatal and serious accidents. The author could not find any evidence of a higher proportion of accidents involving workers whose names would suggest they were of eastern European extraction. Cognizance should be taken, however, of the fact that some of these workers adopted British names after their arrival in this country and this could hide the true rate of injury among such workers.
[22]Whiteside, *Regulating Danger: The Struggle for Mine Safety in the Rocky Mountain Coal Industry*, (Nebraska, USA, 1990), pp 78-83.
[23]See chapter 3, pp 131-133.
[24]J Whiteside, *Regulating Danger.*
[25]*Colliery Guardian*, Vol LXXIII, 15 April 1897, p 733. From paper *'Coal Getting by Machinery'* by Latham.

[26]Ibid, Vol CIX, 26 Feb, 1915, pp 439-441, article by S H Cashmore, '*The Reduction of Working Costs at the Coal Face.*'
[27]Ibid, Vol LXXXI, 25 Jan, 1901, p 182.
[28]Ibid, Vol LXXXI, 18 Jan, 1901, pp 123/4.
[29]*Royal Commission on Safety in Coal Mines*, Minutes of Evidence, 1936, Q 10670 and Q 10671.
[30]*Miners' Eight Hour Day Committee Report*, (B P P), 1907, First Report, Part III,(Cd 3428). Q 1405-1406, evidence of Mr G A Mitchell, Kerr, *Practical Coal Mining*, p 171.
[31]Inspector of Mines Reports, Scottish Division, 1922, p 25.
[32]*Colliery Guardian*, Vol, CXXIX 22 May 1925,
p 1258, L J Barraclough '*A Method of Machine Mining*'.
[33]Ibid, Vol CXLVI, 27 June, 1933, p 169, from a paper by J Brass, *Does Mechanisation Promote Safety?*
[34]*Royal Commission on Safety in Coal Mines,* Minutes of Evidence, 1936, Q32139 to Q32150.
[35]SRO, Wemyss Coal Company Accident books, 1906-1926, RH 4/449, 450, 451.
[36]Inspector of Mines Reports, 1922, Scottish Division, p 21.
[37]Ibid, 1921, Scottish Division, p 19.
[38]GUA, William Dixon Ltd., Accident Report books, 1907-1908, Govan Colliery, UGD/1/34/1. Although this source contains quite detailed information it is for a limited time span, January 1906 to January 1908. It does however provide a useful snapshot of the number and type of injuries in these pits.
[39]Inspector of Mines Reports, 1925, Scottish Division, p 33.
[40]Ibid, 1914, Scottish Division, p 24.
[41]R Small, *The Cry From the Mines: and the Claim of the Miner,* (Glasgow c.1911), p 10.
[42]Inspector of Mines Reports, 1923, Scottish Division, Table 4 p 10.
[43]Ibid, 1922, Scottish Division, p 20.
[44]Ibid, 1919, Scottish Division, p 35.
[45]*Colliery Guardian*, Vol CXXXII, 25 Nov, 1926, p 1053. Landless comments were made in reply to a paper by L C Maitland '*Some Notes on Machine Mining*', the central question of which was whether the introduction of coal cutters increased the number of accidents.
[46]Miners' Federation of Great Britain,[MFGB] Annual Proceedings and Committee Minutes, Special Conference, March 1911.
[47]MLG, MFGB, Annual Proceedings and Committee Minutes , Special Conference, April 1911.
[48]*Royal Commission on Safety in Coal Mines*, Minutes of Evidence, 1936, para 16 and information contained in Graph 5, from the evidence given by Mr J A B Horsley OBE, Chief Electrical Inspector of Mines.
[49]Ibid, Q 10040,10041 Evidence of E H Frazer. Also see Q 25021, 25022 evidence of R J Shaw, National Association of Colliery Managers, (NACM).
[50]Inspector of Mines Reports, 1922, Scottish Division, p 15.
[51]Ibid, 1930, Scottish Division, pp 21-22.
[52]Ibid, 1935, Scottish Division, p 14.

[53]Ibid, 1921, Scottish Division, p 27.
[54]Ibid, 1922, Scottish Division, pp 16-17.
[55]*Colliery Guardian*, Vol CXLI, 21 November, 1930, pp 1886-1887.
[56]Kerr, *Practical Coal Mining*, pp 209-252, chapter eight provides an excellent, detailed description of the longwall and stoop and room systems of mining. The length of the stoops(pillars) and longwall faces being governed by the depth of the working and the geological characteristics of the overlying strata.
[57]Inspector of Mines Reports, 1922, Scottish Division, 1935, pp 50-51.
[58]B L Coombes, *I am a Miner*, p 31.
[59]J Whiteside, *Regulating Danger*, p 46.
[60]Coombes, *I am a Miner*, pp 32-34. Also see the excerpt from B L Coombes in J Burnett, (ed) *Useful Toil, Autobiographies of Working People from the 1820s to the 1920s*, (1988), p 103.
[61]B Smith, *Seven Years in the Dark: A Miner's Life*, (Barr, Ayrshire, 1991), p 94.
[62]Inspector of Mines Reports, Scottish Division,1935, p 49.
[63]*Royal Commission on Safety in Coal Mines*, Minutes of Evidence, 1936, Q 27058 evidence of J Jones of the MFGB.
[64]ARHMCIM, 1935, Table 53, pp 184/5.
[65]*Royal Commission on Safety in Coal Mines*, Minutes of Evidence, 1936, para 16, evidence of J Jones of the MFGB.
[66]See chapter 3, p 117.
[67]*Royal Commission on Safety in Coal Mines*, Minutes of Evidence, 1936, Q 10384, evidence of E H Frazer.
[68]See page 182.
[69]Inspector of Mines Reports, 1906, East Scottish Division, p 20.
[70]Ibid, 1906, East Scottish Division, pp 8-10.
[71]List of Mines, 1906.
[72]See Chapter 2, p 67, LICC is first recorded as employing coal cutters in 1905.
[73]*Royal Commission on Safety in Coal Mines*, Minutes of Evidence, 1936, evidence of H J Humphrys, Yorkshire.
[74]*Final Report of the Departmental Committee on the Probable Economic Effects of a Limit of Eight Hours to the Working Day of Coal Miners,* (B P P), 1907, Part I & II, (Cd 3505,3506), p 48.
[75]*Report of the Miner's Eight Hour Day Committee*, (B P P), 1907, Part III,(Cd 3428), Q1907, evidence of Henry Mungall, chairman of United Collieries Ltd., Managing Director of Edinburgh Colliers, Robert Addie & Sons, Arniston Coal Company, Earl of Rosslyn's Collieries Ltd., and a director of the Fife Coal Company Ltd.,
[76]Ibid, Q3563, Q3564, evidence of A.Bowman, Rothes Colliery, Fife.
[77]Ibid, Q3000, evidence of J Strain, chairman of John Watson Ltd.,
[78]Ibid, Q1434, evidence of G A Mitchell of Kerr and Mitchell, director of the Lochgelly Iron and Coal Company Ltd., and president of the MAGB, 1906-1907.
[79]Ibid, Q963, evidence of J S Dixon. Dixon was one of the first district representatives of the LCMA when the association was formed in 1887. He became vice president in 1895.
[80]*Colliery Guardian*, Vol CIII, 21 June, 1912, p 1237.
[81]List of Mines, 1906.

[82]See table 2.1.2, p 63. It is noted that the average pit employed between 100-499 workers in 1914, 46 percent of Scottish and Fife mines fell into this category. Thus the mines sampled are acceptable as they reflect a typical Scottish mine.
[83]I.MacDougall, (ed), *Militant Miners*, (Edinburgh, 1981), p 58. John MacArthur started work at this pit in 1922 and notes it was worked exclusively by hand at that time, however, he also mentions that coal cutters were introduced shortly afterwards.
[84]The injury rate for 1921 was 50 per 1,000, by 1923 it had risen to 216 per 1,000. Wemyss Coal Company, Accident Books 1906-1926, SRO,(WRH), RH.4/142/449, 450 and 451.
[85]Fifteenth Annual Report for the Secretary of Mines, 1935, p 15. The Secretary notes that the expansion in mechanical mining in recent years has been by the extended use of machines in mines already using them, rather than by the introduction of machines in more mines. He provides figures for 1928 when 908 mines out of 2,539 were using coal cutters and produced 26 percent of total output. In 1935, 844 mechanised mines out of a total of 2,075 produced 51 percent of total output. Thus, the increase in production was achieved by intensive, not extensive expansion of mechanisation. N.B. the figures relate to Britain.
[86]*Royal Commission on Safety in Coal Mines*, (B P P), 1938, (Cmd. 5890), p 69.
[87]Ibid, p 70.
[88]Ibid, p 68.

CHAPTER 5

Labour Relations in the Scottish Pits.

This chapter will investigate industrial relations in the Scottish coal fields during the 1890-1939 period. Once again the impact of mechanised mining methods will constitute a strong theme throughout the section. The arguments that labour were opposed to the introduction of new technology in the form of machine coal cutters and mechanical conveyors and adopted an obstructive stance to the diffusion of such machines within the industry will be scrutinised. The attitudes of mineworkers, at both trade union leadership level and within the rank and file, will be analysed to ascertain whether a dichotomy existed within organised labour and if so did a difference in attitudes to the advent of modern mining practices manifest itself in acrimonious labour relations. A survey of industrial relations within the Scottish mines will be conducted to determine the primary causes of labour unrest in the period. Although the investigation examines Scotland as a whole the main emphasis is the Lanarkshire coalfield. Two periods have been selected for intensive analysis. The first and most comprehensive case study will cover the volatile years of 1910-1914. The second case study will cover the years 1932-1938 which ushered in another period of heightened labour conflict as the economic upturn of the mid-decade raised expectations and provided an opportunity for 'claw-back' of labour territory. While exploring all causes of labour unrest in mining, special attention is given to testing J H Goldthorpe's theory that the shift to intensive machine mining resulted in deteriorating industrial relations.[1] To reiterate, Goldthorpe argues that management's need to co-ordinate underground operations through closer and stricter supervision and intensification of the work process led to an alienated workforce. The threat to colliers' autonomy and control in the workplace led to clashes between management and miners and thus ensured industrial relations remained bitter.

To supplement these studies an investigation of industrial relations in the Ayrshire coal field in the thirties will also be conducted. This area witnessed a rapid growth in machine mining technology in this period and, thus, should prove a fruitful area for any study trying to establish whether a link exists between mechanisation and industrial conflict. But firstly, attention will be directed to the various arguments which show mine labour as adopting an obstructive stance to the introduction of new mining methods.

Progressive or Obstructive? Scottish Mineworkers and Mechanisation.

One of the major tenets on the causes of Britain's declining economic role is that the country suffered from entrepreneurial failure. British businessmen stand accused of failing to adopt the innovative technological and organisational changes which underpinned the successful challenge by her German and American rivals.[2] B Elbaum and W Lazonick advance this argument.[3] They contend that one factor affecting Britain's inability to match the success of her competitors was the presence of strong labour organisations. These commentators view the rigid work rules of British unions as an obstacle to change because they denied British entrepreneurs the right to manage the utilisation of technology.[4] The belief that obscurantist attitudes and policies of organised labour were detrimental to the economic well-being of the country was clearly indicated in the following comment by J Ellis Barker during the first World War:

> the most pernicious feature of British trade unions is their policy of limiting output, and their hostility to improvements in organisation and machinery. Their activity has upon the body economic an influence similar to a slow fever which leads, almost imperceptibly, to atrophy, to marasmus, and to death.[5]

Furthermore, a frequent reply of mineowners to public and government criticism of their failure to modernise the industry stressed the opposition of labour to technological and organisational change. G A Mitchell, for example when giving evidence to the Miners' Eight Hour Day Committee in 1907, was confronted by the statement that British employers had been reproached for their want of enterprise as regards the adoption of machinery. Responding to this criticism Mitchell indicated that there had been considerable progress in introducing coal cutting machines in Scotland's pits in recent years but emphasised that:

> the introduction of machines had not been affected without great difficulty. The miners have not given the facilities that might have been hoped for, and in many cases there has been organised opposition on their part.[6]

Henry Mungall, chairman of United colliers made similar comments to the committee. He stressed the role played by the union leadership emphasising their hostility to the implementation of new work methods and told the committee that many strikes had taken place.[7] An article in the *Colliery Guardian* at the turn of the century castigated British mining unions, attributing rising costs of production in the industry to their restrictive practices with regard to the expansion of machine mining. 'The industry was fettered by the labour movement more severely than the mining industries of other countries'.[8] In a similar vein another article stated that the attitude of miners, particularly in the early years of mechanical innovation, was at best unpredictable and at worst openly hostile.[9] Several commentators have highlighted the findings of the Technical Advisory Committee of the Ministry of Fuel and Power, 1944/45, known as the Reid Report so called after the chairman Sir Charles Carlow Reid previously chairman of the Fife Coal Company. This committee claimed that one of the reasons behind the lack of investment in new technology and restructuring in mining was, 'the lack of co-operation between owners and miners as indicated by the reluctance of the latter to accept mechanisation as a necessity'.[10]

The fears uppermost in the minds of mineworkers about machine technology appears to have been the effect it would have on wage and employment levels:

> The truth is that the miners were suspicious about the machines, which they regarded as *silent blackleg workers* depriving them of their jobs and lowering their status and wages, and the unions were determined to ensure that all precautions were taken to offset their bad effects on labour conditions. 'Machine versus men' was an old refrain in the miners' mind. " When the work is done by the machine we shall no longer be necessary, or only a few of us. And what will be our wages against the background of mass unemployment and cheap machine-power, which works twice as much at half the cost? And shall we be able to keep pace with the machine? The machine can work incessantly for twenty-four hours at a high speed and we can't.[11]

There is some evidence that this initial reaction of labour was overcome relatively quickly. G L Kerr argued that the anxiety of colliers was rapidly surmounted:

> Another difficulty which has had to be contended with has been the labour question, the workmen in many districts having a prejudice against the use of coal-cutting machines, on the ground that the introduction of such machinery will dispense with the need of hand labour. This phase is usually temporary, and is the result of misapprehensions of the influence of machine mining on employment and wages. Where the men have had experience of machines they have found them altogether beneficial to their interests; and when there is a choice of working in machine-got or hand-got sections, they usually prefer the former, for they earn higher wages for less irksome work.[12]

Other commentators confirm this view. For example, A Dury Mitton, in a paper delivered to the Manchester Geological Society in 1903, acknowledged that some miners were still prejudiced against coal-cutters but felt that the more these miners worked with machines the less they feared the worn out cry about the 'iron-man superseding the collier'.[13] If labour opposition to machine mining was, as this evidence suggests, ephemeral why is the theme of opposition so strong in the various source material? Surely, there must be some justification for the continual references to this phenomena.

Despite the above evidence there does not appear to have been any direct opposition to machinery. After a comprehensive search of numerous source material covering a half century this author has been unable to find any instance of a dispute or strike having *directly* resulted from management's intention to install machinery, of whatever description, in a Scottish colliery. However, numerous indicators exist which point to labour unrest arising from the proposed remuneration that owners offered for working under these new conditions. A Campbell, in an article on mechanisation in the Lanarkshire pits, stresses this point:

> Despite the miners' deep rooted and interconnected anxieties about issues such as safety, contracting and deskilling which were associated with mechanisation, there were no campaigns mounted nor policy decisions taken against machinery *per se*. The numerous strikes connected with the introduction of coal cutters focused not upon the principle of mechanisation but instead upon filling rates and working arrangements. They represented the negotiated acceptance of machinery by miners and their union.[14]

Thus, wages and conditions which accompanied mechanisation were the main source of labour unrest. Both G A Mitchell and H Mungall when pressed by the Miners' Eight Hour Day Committee acknowledged this to be the case. Mitchell when questioned by Sir R A S Redmayne on whether the unrest stemmed from a question of remuneration stated that he had known instances where mineworkers wanted as much for filling machine-cut coal as they formerly had for cutting and filling.[15] An editorial in the *Colliery Guardian* in 1909 gives further evidence that the conditions which machine mining techniques brought with them were the crux of trouble in the industry:

> It may be a matter of general belief that the theoretical antagonism to machinery, on the grounds that it creates unemployment, has been so falsified by experience as to render such an attitude un- tenable: it may be true that antagonism of this crude description is a thing of the past, so far as most enlightened craftsmen are concerned... Nevertheless, formidable impediments have been opposed to the introduction of machinery through a desire on the part of the workman to take the greater portion of profit derived from its use, or their resentment to any reduction in their status as workmen or their earning power.[16]

Although no examples of direct opposition to the introduction of mechanisation have been found evidence of disputes over proposed tonnage rates in machine-runs abound. References to such issues are found throughout the period. For example, as early as 1904, when machine mining was in its infancy, a strike occurred at the Redding mine in Stirlingshire over the proposed tonnage rate in a machine-run.[17] Other examples include the cases at Russell's Whistlebery and Loanend collieries in 1921. Miners at both pits refused to accept the rates proposed by management when machinery was introduced, arguing that the rates were too low for the work in question.[18] Reference is also made in the records of the Lanarkshire Coal Masters' Association for the same year to a dispute at one pit in the county over a reduction in tonnage rates when the system of working was switched from bord and pillar to longwall. Mine management reasoned that cutting conditions had been made easier.[19] These few examples provide an indication of how the new working systems associated with machine mining could lead to friction in the industry as workers tried to maintain traditional work practices and methods of payment.

Evidence exists, however, which shows machinemen earned less than hand-hewers at various Lanarkshire mines in the years prior to 1914. At Eddleswood Colliery and the Swinhill Colliery in 1907, for example, machine miners were given financial backing from their union to fight management's proposed cut in their wages which would have brought them below the basic wage. Thus, showing that this class of workman, far from earning more than pick miners, were threatened with earnings which failed to meet the industry standard.[20] A similar case took place at the Cadzow mine in 1909. The Lanarkshire union decided to bring the machinemen out on strike over low wages. It is noted in their records that machinemen were earning five shillings per shift at the pit and had been for over 6 months. Mineworkers had recently established that 6 shillings per shift was the recognised basic wage in Scotland.[21] Indeed, management's threat to reduce wages below this datum had almost led to a British national strike in the industry in that year.[22] Thus, machinemen at this colliery had been earning considerably less than the recognised minimum wage for most of the year. Far from being among the top earners in the industry, cuttermen at these pits failed to match the earnings of traditional hand-hewing mineworkers. Therefore, to say labour opposition to new technology was overcome because of the possibility of enhanced earnings as Kerr implies, is unfounded.

As noted earlier, mineworkers viewed the introduction of mechanical conveyors as a much greater threat to employment than they had machine cutters.[23] J L Carver adopts a similar line in his study on machine mining:

> There was even less enthusiasm for the conveyor than there was for the coal-cutter. The miners were not, as a rule, opposed to the introduction of the latter, but the problem of fixing new piece rates had always to be solved. They were not so sure about the advantages of the face conveyor which they feared would eliminate their labour.[24]

Perhaps one reason why this feeling of labour opposition to new technology pervades the half century of this investigation is because the mechanisation of mines was carried out in a piecemeal fashion. There was no organised nor orchestrated modernisation scheme within the industry. Coalfields, collieries and, indeed, sections of individual mines adopted machine mining practices intermittently throughout the period. This uneven development of the industry is one factor, Campbell argues, which accounts for the lack of opposition because by the very nature of its spasmodic introduction it was not perceived as a threat by rank and file miners.[25] However, working on the basis that there is no smoke without fire, perhaps Supple is nearer the mark with the following observation:

> A degree of antipathy to new methods, a latent 'culture of anger' and even occasional acts of sabotage resulted from the introduction of mechanisation...but in the event there was little effective opposition to the introduction of new techniques, however, the fact that labour productivity grew with such painful slowness may indicate that recalcitrant attitudes had a more subterranean effect.[26]

The idea of 'a latent culture of anger' and the 'subterranean' effects of' recalcitrant attitudes' will be analysed in more detail later in this chapter. However, before moving to the case studies of labour relations in the Lanarkshire coalfield some attention will now be devoted to the argument that Scottish mine labour and mine union leadership did not obstruct the introduction of mechanisation and, indeed, adopted a progressive attitude to modernisation within the industry.

The policy of the Miners' Federation of Great Britain (MFGB) appears to have been neither one of limiting output nor of hostility to improvements in organisation and machinery. Indeed, it seems that, at executive level at least, organised mining labour was supportive of modernisation. In 1919, for example, Robert Smillie, for many years leader of the Lanarkshire miners and the then president of the MFGB, advocated at the annual conference in Keswick for an extended use of machinery within the industry.[27] This official union line was still being upheld some twelve years later by Ebenezer (Ebby) Edwards. In his presidential address to the MFGB Edwards called for 'the fullest application of scientific methods in the production, treatment and utilisation of coal'.[28] This statement formed part of the MFGB's policy for the coal industry in the early thirties. Moreover, as the MFGB had agreed to and supported the modernisation and rationalisation programme reached at the Mond-Turner talks of 1927-1929, it seems unjust to brand organised labour, at this level, pernicious. Later still, in the early years of the second world war, it was the workers in the industry who championed the acceleration of machine mining methods. Mining unions at this time asked, 'that mechanisation should be pushed ahead as far as possible, and the highest priority be given for mining machinery and spare parts'.[29]

Yet this progressive view of change in the industry was not shared by all mineworkers. Investigation of the Lanarkshire Miners' County Union,(LMCU) records indicate that some branches were vehemently opposed to the line being adopted by the union hierarchy:

> This meeting of branch 32 (Douglas Park) congratulates A J Cook on the stand he has taken on the general council of the T U C against the present treacherous policy of industrial peace. It assures comrade Cook of its whole-hearted support and expresses the hope that he will continue vigourously to fight the battle of the working class, even though the obstacles he has to face on the general council are so tremendous. This branch demands that a verbatum report of the Industrial Peace Conference, (Mond-Turner Talks) be sent out to the rank and file of the various organisations affiliated to the Trade Union Congress.[30]

Similar resolutions were proposed by branches at Milnwood, Bothwell Castle, East Parkhead, Coalburn and Rosehall.[31] Further evidence that a dichotomy existed between trade union leadership and the rank and file was highlighted in a speech by J Jones, president of the MFGB in 1938. Jones viewed the strike weapon as being out of date. In an attack on unofficial stoppages he commented thus:

> Today the strike weapon was out of date; indeed, unless faced with an extremely intractable opposition, no modern miners' leader could advocate such a course...A warning against unofficial strikes which had grown in frequency and extent and an attack on advocates of 'direct action' to enforce the redress of grievances. Frequently occurring unconstitutional stoppages undermined the influence and strength of a trade union, often humiliated responsible officials, always enfeebled the prospect of successful negotiation and accommodation adjustments, and seldom failed to alienate public opinion.[32]

The rift within mining trade unions lasted throughout most of the period under investigation and was fuelled in part by the difference in attitudes to mechanisation of coal mining and the concomitant changes demanded by new technology. It may be that workers with 'hands-on' experience of the effects of technological change had valid reasons for their opposition.

Obviously, however, not all workers in the industry were out of tune with union leadership on the issue of mechanisation. J Masterton, Inspector of Mines for the Scottish division in the 1920s and 1930s held the view that Scottish miners, far from being reluctant to accept machinery, were a positive force behind the success of the new methods:

> In Scotland, at least, they had the workmen to thank for a lot of the success that had been achieved. In other parts of Britain the workmen are up against mining machinery of all kinds, but in Scotland, if a machine is installed and explained to the men, the latter would be found most helpful.[33]

In his annual report for the following year (1928), Masterton again praised Scottish mineworkers and mining staff for their cooperation in making these new extraction methods a success:

> Wherever the fault with the coal industry lies it is not with those in technical charge and I have drawn attention before to the manner in which the miners in Scotland respond to the introduction of machinery and give their best.[34]

A Muir, in his history of the Fife Coal Company also notes how quick colliers with this firm were at adapting to various new forms of mining equipment.[35] Further testament to the willingness of mineworkers to get the best from new mining methods is given by A Reis. Reis a mining engineer from Cowdenbeath, extolled similar views to Masterton's in a paper, on the installation of belt conveyors, which he gave to the Mining Institute of Scotland in December 1927, 'the men had all along cooperated in a most loyal way'.[36] These examples from the management side of industry and from an independent government official, that is, people who would have little to gain from supporting the cause of mine labour, show Scottish mineworkers as being much more receptive to technological and organisational change than is suggested in the Reid report.

Another mining engineer, R Westwater, at a meeting of the Mining Institute of Scotland in the mid-thirties also commented on the difference in attitudes of Scottish and English miners to mechanisation. He agreed that Scottish miners seemed to be more receptive to new technology but suggested this stemmed from the weakness of labour organisation north of the border.[37] Trade union membership in Scotland was lower than the national average. Effective unionisation came later and proved somewhat more fragile. Indeed, in 1935, 42 percent of Scottish miners were union members, whilst the corresponding figure for Great Britain was 64 percent.[38] Westwater may, in part, be correct. Relatively low union membership and the internecine battles between the National Union of Scottish Mine Workers (NUSMW) and the break-away United Mineworkers of Scotland (UMS) could have resulted in colliers being too divided and weak to oppose mechanisation. This weakness, however, does not explain why mineworkers were as helpful and cooperative as Masterton and Reis claim. The chapter will now devote some time to the case studies of industrial relations in the Lanarkshire coalfield. Before concentrating on the first period of investigation a brief overview of union organisation in Lanarkshire and of combination among coal owners will set the studies in historical context.

Historical Overview of Industrial Relations in the Lanarkshire Coalfield.[39]

The history of labour organisation in the Lanarkshire pits during the first three quarters of the nineteenth century receives detailed analysis in Campbell's comprehensive study of these workers.[40] From the mid-1870s to the early 1890s, however, labour organisation in Lanarkshire mines was characterised by numerous, small, short-lived trade unions organised on a local basis. In 1886 an attempt was made to organise a national union - the Scottish Miners National Federation. One of the main forces behind this movement was Keir Hardie. This also proved to be as ephemeral as earlier attempts. On the plus side, however, this short-lived national body did help stimulate a movement toward county unions and this, along with the exceptional organisational work of William Small, led to the formation of the Lanarkshire Mining Federation in 1893. This union subsequently became the Lanarkshire Miners' County Union in 1896. A primary aim of this body was to gain recognition from employers. This was achieved in 1899-1900 when a Conciliation Board was established. Another objective was to get a minimum wage for miners. This goal was achieved in January 1900 and mineworkers secured further wage increases until mid-1901.[41] These advances had been secured during the economic boom of 1889-1900 which saw Scottish pithead prices reach 14/- per ton, their highest pre-war level.[42] By 1902, however, owing to a downturn in trade, coalmasters were successful in linking the minimum wage to a sliding-scale. Between 1902 and 1909 various wage agreements were concluded, generally on advantageous terms to the owners. In 1909 the minimum wage was 6/- per day. This was the absolute minimum recognised by the British national union, the Miners' Federation of Great Britain. Indeed, according to the rules of the MFGB, if Scottish owners tried to reduce wage rates below this datum English and Welsh miners were duty bound to come out on strike in support of the Scots. This was the position in August 1909 when further wage cuts were proposed. Thus, the first ever national strike of British mineworkers was on the cards.

The gravity of the situation led to government intervention. Winston Churchill and George Askwith succeeded in getting miners and owners to put the dispute before an independent chairman, Lord Balfour of Burleigh. The final outcome was that the six shilling a day minimum was recognised but it was tied to a much harsher sliding-scale. If, for instance, economic conditions warranted that the minimum should be less than six shillings for a period of (say) six months then following an economic upturn which merited a wage rise the increase would not be paid for six months. Thus coal owners would have been compensated for their earlier 'loss'. The inequitable terms of this wage settlement and the feelings of hostility to owners and the Government was a major ingredient in the level of unrest in the following years.

In fact the first national strike of mineworkers in Britain occurred in 1912. The main bone of contention was the issue of 'abnormal' places, or, as this was known in Scottish pits, 'deficient' places. Miners working these places were unable to make a living wage through no fault of their own. For example, geological conditions may have been such that hewers were unable to cut their required '*darg*', or daily quota. Other factors included excessively wet conditions or production hold-ups outwith the control of the men, for instance machinery breakdowns. Disputes over such conditions were usually settled through individual negotiation between the miner(s) concerned and management. Scottish coalowners acknowledged that pitmen in these situations were entitled to a fair wage but there was no agreement as to what constituted a deficient place or, indeed, a fair wage. As this issue was outwith the remit of the various conciliation boards it was decided at national level to campaign for an individual minimum wage. The minimum wage achieved by miners in 1900, it should be noted, was a guaranteed wage when working under normal conditions. It took no account of men working in abnormal places unable to earn the standard wage. Negotiations with employers continued throughout 1911 and into 1912 when a ballot on whether to strike over the issue was taken. At national level the majority in favour of strike action was 4:1. In Scotland it was 5:1.[43] The first ever national strike of mineworkers in Britain began on 1 March 1912 and ended six weeks later with the loss of 30 million work-days.

Again the seriousness of the situation prompted government intervention. A week before the strike Prime Minister Asquith stated in a letter to the MFGB:

> The Government recognises that it is not right, it is not just, that it is not in the interests of the community that this great interest of yours should be carried on without adequate securities and safeguards for the attainment by underground workers of a reasonable minimum wage.[44]

The government, who were also consulting with the employers, proposed that a Bill be enacted which encompassed four main points. The principle of an individual minimum wage would be established. The wage would be set by district boards taking district circumstances into consideration. If a failure to agree was reached Government representatives would arbitrate. Mining unions were completely against compulsory arbitration. They also wanted a schedule of district minima incorporated within the legislation to guarantee minimum wage levels. Lloyd George, during negotiations with Robert Smillie, president of the MFGB, advocated they should take a more moderate line emphasising that this would be the first time in history a minimum wage would be legislatively established. Smillie in response, stated that a minimum wage had been established by Lloyd George in 1911 when he passed a minimum wage act for Members of Parliament:

> £400 per annum irrespective of their efficiency, lunacy or malingering propensities... and if you can put figures in a Minimum Wage Act for M.P.s without objectionable clauses, surely you can do the same thing for miners.[45]

The wily Welshman, it was noted, replied in silence.

The Bill, in its original format, became law on 29 March which prompted a second national ballot. A narrow majority of members were in favour of continuing industrial action, Scottish mineworkers voting 244,000 to 201,000 for continuation of the strike.[46] Union leaders advocated a return to work to await the outcome of the District Boards. Smillie argued that the men returning '*en bloc*' would be taken as a show of strength by the independent arbitrator. A sectional return may be viewed as a weakness and could reduce the amount of settlement. Smillie was also concerned that further action by Scottish and Welsh miners would deplete union funds and thus, the union would be unable to strike again if the arbiter's award was insufficient.

Scottish coalmasters who, along with their counterparts in South Wales, had steadfastly refused to concede the principle of the individual minimum wage, did take part in the District Boards but still refused to give ground on the issue. David Gilmour of the Lanarkshire Miners' Union stated at a conference on the issue that in Scotland:

> just as before the strike our owners would concede nothing and they have continued in the same spirit from the beginning to the end. We were not able to agree upon anything. If we looked through the window and said the sun was shining or a statement of that kind we could not agree...our owners have never given the slightest intimation of trying to carry out the Act. Hardly a single colliery has recognised the Joint Committees...We have got rather less than nothing. We are in this difficulty that some of the strongest companies in our county have absolutely violated the spirit of the law, they have dismissed men of thirty years of age unless they would sign an agreement to be outside the Minimum Wage Act. We have almost 20 percent of the men employed at one big company in which the men have been dismissed or forced to sign outside the Minimum Wage Act or through threats of dismissal.[47]

Once again the draconian attitudes of coalmasters and government intervention had left mineworkers feeling cheated and betrayed. Page-Arnot posits the view that, 'this feeling of betrayal had the effect of welding them [miners] more closely together both within Scotland and throughout the British coalfields'.[48]

However, coal owners and government ministers and officials were not the only targets for resentment from mineworkers. Trade union leadership both at county level in Lanarkshire and at national level was increasingly under attack from some sections of the workforce. Indeed, this point was underlined at a MFGB conference in April 1912 by a Scottish delegate who commented, 'the rank and file in Scotland felt sold down the river by leaders'.[49] This split between trade union leadership and some sections of the rank and file will be considered in more depth in the following examination of the patterns, nature and causes of industrial unrest during the 1910-1914 period. Before that, however, some attention will now be devoted to organisation among Lanarkshire coal owners in the years before the outbreak of the Great War.

Employer Organisation, The Lanarkshire Coal Masters' Association.

The Lanarkshire Coal Masters' Association was formed in 1886 in response to the growing combination of mineworkers in Scotland, who in the same year had formed the Scottish Miners' National Federation.[50] The first annual report of the LCMA, in 1887, states that the association was founded because 'the miners of Lanarkshire formed a strong combination to unduly force up wages.' The primary aim of the association was to regulate wages in accordance with the state of trade, and also 'to protect its members against strikes and blocks[51] on the part of the workmen on questions of general interest to the coal owners.'[52]

A sliding scale system of wage regulation was agreed upon in July 1887. A base rate was set at four shillings and one penny per ton with wages rising or falling 2.5 percent for every advance or reduction of 1.5 pence.[53] However market conditions and the actions of coal owners outwith the association resulted in the abandonment of wage agreements on numerous occasions. For example, owing to buoyant trading conditions and high prices in the latter half of 1889 the sliding-scale was cancelled when miners got wage increases of 6^{d} in August, October and November of that year.[54] The fact that many masters remained outside the association also limited its effectiveness. In 1893 during the coal strike in the English Midland region, Scottish miners campaigned in August of that year for an increase of one shilling per day. The LCMA agreed to an increase of 6^{d}. However, some coal owners outwith the association, Archibald Russell being one example, conceded the shilling increase. Within days the LCMA was forced to concede a second 6^{d} rise.[55] A similar situation arose in 1898 during a strike in Wales when the LCMA was again forced to give a wage rise because of the independent action of owners outwith the association.[56] If the association was to ensure effective wage regulation then the majority of the larger independent coal masters in Lanarkshire had to be encouraged to join.

The original membership consisted of 49 firms controlling 64 mines in the Lanarkshire area. In a purely numerical sense this represented slightly less than one quarter of the mines in Lanarkshire at that time. No indication of the output nor the numbers of miners employed by these founding members is given, thus it is difficult to gauge how representative this employers' association was of coal owners in the area. The full membership of the association is not listed for any year in either the association's annual reports or in the directors' minute books. For the year 1896 fourteen members attended the Annual General Meeting.[57] These firms owned 55 mines in Lanarkshire which represents 21 percent of the total mines in the county and gave employment to 12,696 miners which was approximately 30 percent of the Lanarkshire total.[58] This figure for the number employed by association members compares favourably with Church's estimate of 25 percent for the late 1880s early 1890s.[59] However, it must be stressed that this figure is an estimate. It is not known what percentage of members attended the AGM. Nevertheless, it is reasonable to assume that larger mine owners would have been represented. Still the relatively low density of membership in this early period would have proved a stumbling block to maintaining cohesive industrial relations policies and district-wide wage agreements, thus curtailing the effectiveness of the association.

The need to strengthen the position of employers *vis a vis* the growing organisation of labour was highlighted during the Scottish 'national' strike in 1894. The extent of combined action of the miners and the solidarity and duration of this stoppage took many coal owners by surprise. 'At no former time had a strike in Scotland been so general. Practically the whole of the miners were out all over the mining districts'.[60] Nearly 70,000 mineworkers downed tools in the course of this four month strike. This represented approximately three fourths of the Scottish mining workforce. In the face of such opposition the LCMA renewed its efforts to extend membership of the association.[61] This policy of expansion to strengthen the position of employers is a common theme throughout the quarter century prior to the First World War. A K McCosh, of Wm.Baird & Co Ltd., highlighted the need, and the reason for closer homogeneity among coal owners in 1907 when he stated 'the association needed to get more large coal owners to join so that they could put their foot down when the men took up an unreasonable attitude'.[62] The refusal of Archibald Russell to join the LCMA appears to have been a major stumbling block to the growth of the association. Many of the other large coal producers would not commit themselves to membership unless Russell also joined. Examples of these coal owners included Wilson and Clyde Coal Company Ltd., United Collieries Ltd., and the Glasgow Coal Company Ltd.[63] Russell's was one of the major employers in the region. In 1914 this company, employing 5281 miners, was the third largest coal concern in Scotland.[64] To have such large producers acting independently of the association could, and did, seriously undermine the power of the LCMA. In 1907, a few years after the death of Russell, this company and thirteen others joined the employers' association.[65]

The next large increase in membership occurred at the end of 1912 when the association recorded 63 coal companies as members - membership earlier in the year was just 39.[66] Using a similar method to that used above it has been possible to identify 28 of the 39 who held membership of the association in early 1912. Three of these firms; the Banknock Coal Company Ltd., the Kinneil Cannel and Coking Company Ltd., and the Woodilie Coal Company Ltd., worked mines outwith Lanarkshire - an amendment to the rules in 1907 allowed collieries in adjacent counties to Lanarkshire to become members.[67] The remaining 25 firms worked 102 mines in the county which equalled slightly more than 45 percent of the Lanarkshire total in that year. Thus, whilst the evidence is inconclusive, it appears that the LCMA had more than doubled the number of pits under its control since 1896. The number of mineworkers employed by association members had also grown dramatically. Indeed, 40,417 miners were now employed by collieries who were members of the Lanarkshire Coal Masters' Association.[68] Consequently, 69.8 percent of Lanarkshire mineworkers were in the employ of coal owners who have been traced as being members of the employers' association. The workforces of the eleven firms which research has failed to identify have still to be added to this total. Therefore, the actual number of miners employed by members of the association must have been in excess of 70 percent of the county's total mineworking population and was possibly higher than 80 percent. This constitutes a significant increase on the 1896 estimated total of 30 percent. When the proportion of mines and level of employment of coal owners who belonged to the association is considered it becomes apparent that a disproportionate number of larger mining concerns were enrolling in the employers' association. Clearly then, coal masters who were affiliated to the LCMA should now have been in a more advantageous position with regards to labour relations and wage negotiations.

The association, although it suffered from its limited membership in the earlier years, took an antagonistic stance toward organised labour throughout the period. There are several instances where the LCMA refused outright to recognise the miners' trade union. In 1893, for example, communications from miners' leaders; R Chisholm Robertson, William Small and Robert Smillie requesting a joint conference with the LCMA, the Ayrshire Coal Masters' Association, and the Airdrie, Slamannan and Bathgate Coal Masters'

Association to set up some sort of collective bargaining system to prevent future conflict was ignored by the association, whose membership stated their preference for dealing with their own mineworkers directly, that is, these coal owners preferred to adopt the divide and rule principle to keep the miners isolated and, therefore, weak.[69] Three years later another proposal from union leaders to discuss ways of improving better conditions for the miners and the industry was refused by the LCMA, although the Airdrie and Slamannan coal owners thought the offer should be accepted. After further discussion between the coal owners the Airdrie and Slamannan representatives agreed to follow the harsher LCMA line.[70] This suggests that the LCMA may well have held much stronger anti-union views that other coal producers in the region. This hypothesis is supported further by other evidence.

The LCMA, in 1897, become members of the Free Labour Protection Association (FLPA), whose main aim was to provide employers with a supply of 'free labour', or strike breakers during periods of conflict. J S Dixon, president of the LCMA at that time was 'much impressed with the possibilities for good which the FLPA was likely to exercise on labour questions.'[71] The LCMA were also interested in the FLPA's intention 'to deal with picketing in the provinces.'[72]

Other tactics employed by LCMA members which support the theory that this group was one of the more hard-line and anti-unionist of employers' associations were the use of 'Ejectment Notices,' - the eviction of workers from their homes during strikes. An example being the eviction of several miners and their families during a strike at the Cadzow Colliery in 1900.[73] Furthermore, an agreement was reached between member companies not to employ any workmen who had been locked out of a fellow member's pit until the dispute had been settled.[74] The association actively encouraged and financially rewarded members to prolong certain types of dispute. The issue of non-union labour, for instance, resulted in workers holding morning meetings to discuss this problem. The LCMA, following a proposal of J M Strain, John Watson Ltd., in an effort to punish miners advocated that members should lockout the men out for a further two days in an attempt to deter this practice. The coal owners being compensated for lost profits incurred through these stoppages.[75] The Lanarkshire Coal Masters' Association, thus, adopted an extremely antagonistic policy toward labour and staunchly defended this anti-union philosophy.

The coal masters were, however, pragmatic. Owing to the buoyant state of trade at the turn of the century the LCMA finally acceded to the formation of a conciliation board for the regulation of wages and other matters. This decision was taken, however, following a meeting of representatives from all Scotland's coalfields, and it can be argued that it was pressure from owners outwith Lanarkshire that helped dilute the LCMA's normal hard-line stance.[76] Despite this concession on their part the association eveventually turned this situation to their advantage.[77]

Industrial unrest in the years before World War I was on the increase. Table 5.1 depicts the rise in disputes that the LCMA considered to be of *general interest to the coal owners* and, thus qualified for compensation payments from the association. The increasing cost of these stoppages reflects the increase in numbers involved and the duration of strikes and lockouts.

TABLE 5.1 MEMBERSHIP, DISPUTES AND COMPENSATION LEVELS, LANARKSHIRE, 1909-1914.

Year	Membership	Disputes	Compensation
1909	36	-	£ 159: 9:2
1910	36	10	£ 1,081:12:1
1911	-	7	£ 7,127:11:8*
1912	63#	4	*
1913	63	17	£ 6,856:15:9
1914	62	47	£11,610: 9:5

Total at year end, it was 39 at the AGM in May.
* Figure shown for 1911 covers compensation payments for both 1911 and 1912.
Source: Glasgow University Archives,(GUA), LCMA Annual Reports, 1887-1918, UGD/159/2/1.

The number of disputes listed above, it should be remembered, apply only to those stoppages which the association considered as qualifying for compensation. Certain criteria had to be met before coal owners could be recompensed. Strikes had to last three or more days. Disputes had to involve the entire mine, partial stoppages did not qualify and, furthermore, the issue had to be deemed of general interest to the coal trade. In other words, matters judged as local management issues did not qualify for compensation. If coal producers could meet these conditions then they would be compensated for profits lost during a stoppage. The table, obviously, takes no account of disputes which occurred in firms outwith the association. Consequently the data in table 5.1 understates the real extent of industrial unrest in the Lanarkshire coalfield during these years.

There were several reasons behind the substantial growth in membership of the LCMA in the years prior to 1914. The growth of organised labour within the industry had accelerated significantly since the foundation of the LCMA. Organisation of Scottish mineworkers had risen from some 3,100 trade union members in 1890 to 110,800 by 1913. This represents a phenomenal growth in trade union density from 3.8 percent to 75 percent over the period.[78] The prospect of increased industrial unrest from a highly organised workforce was undoubtedly one motivation which helps explain the expansion in combination by coal owners. This is perhaps especially pertinent in explaining the enrolment of smaller concerns. Of the 25 firms which joined the association during 1912, 14 have been traced. Six of this number; Ballochney Coal Company Ltd., Brand & Company, Hirst Coal Company Ltd., Kepplehill Coal Company Ltd., J McAndrew & Company and A G Anderson Ltd., had between them eleven mines in Lanarkshire. The average workforce at these pits was 196.[79] Deteriorating labour relations in the Lanarkshire coalfield was, without doubt, a major influence upon the rising membership level of the LCMA.

The all-pervasive infringement of state intervention (viewed as interference by coal owners) in the coal industry was another major factor influencing employer organisation. Coal owners had resisted the various government Bills connected with the mining industry implemented since the mid-nineteenth century on the grounds of the costs these acts imposed on mine owners. For example, the Workmen's Compensation Act of 1897, it has been argued, caused much concern amongst colliery owners. They felt that £300, (maximum) per death and £1 per week (maximum) for injury was an imposition, 'seeing that [the industry] was so subject to accident, and even catastrophe, which might be attributable to the negligence or oversight of the men affected'.[80]

The Eight Hours Act, 1908, was another area of state intervention that owners viewed with trepidation as regards rising costs and reduced profit margins. At a general meeting of the LCMA in 1900 the fact was noted that some miners and oncostmen in Scotland were working an eight hour day which led, on average, to a reduction in output of 10 percent.[81] Hence, the extended Workmen's Compensation Act and the other 'welfare' acts of the Liberal administration in the years before 1914 coupled with government intervention in labour relations[82] were seen as further threats by businessmen in the coal sector. Through joining employers' associations and organising pressure groups coal producers hoped to derail, or at least dilute the effects of such legislation.

Although the LCMA did not engage in an exhortatory crusade to promote modern mining methods among its members it did avidly support member companies in disputes over their right to introduce new technology. The introduction of machine mining and the concomitant changed working practices often resulted in conflict in the pits. For example, mechanised cutting often led to disputes over drawing, that is transporting coal from the face to the supply roads. The new system of mining saw miners compelled to do their own drawing. Time spent on this activity reduced the time at the face and, therefore, tonnage cut. This meant reduced earnings and so proved a source of conflict in the pits. Drawing disputes at James Gemmell's Hill Colliery and the Darngavil Coal Company's Birkrigg pit in 1910 are typical examples of this phenomenon.[83] Such opposition was looked upon by the owners as a direct challenge to their right to manage and, consequently, such disputes received the support of the LCMA. In this instance the dispute was settled by arbitration with the owners winning the *right to manage*.[84] The hard line adopted by the LCMA *viz a viz* labour relations is evident as analysis of the 1910-1914 period demonstrates.

Labour Relations in Lanarkshire Pits, 1910-1914.

A closer investigation of strike levels and patterns in Lanarkshire mines during the 1910-1914 era elucidates the causes of conflict and the role played by mechanisation. When analysing the extent of strikes during this period it should be noted that official figures shown in Board of Trade data generally understate the level of unrest. Board of Trade statistics take no account of strikes involving less than ten workers or which lasted less than one day. For example, government statistics for Scotland during this quinquennium, for all areas and all occupations, record the total number of strikes as 131. Research by the Glasgow Labour History Workshop has shown this to be a gross understatement. Indeed, this group found that 243 strikes had occurred in West Central Scotland alone.[85] This may also be an underestimate. The level of disputes in Lanarkshire in the years before the great war is outlined in Table 5.2.

The number of strikes in mining shown in the GLHW column in Table 5.2 is for West Central Scotland, that is the counties of Renfrew, Dumbarton, Ayrshire and Lanarkshire whereas the rest of the table concentrates on Lanarkshire alone. Provision of data on industrial unrest by companies to the Board of Trade was on a voluntary basis. Some firms chose to ignore requests for such information.[86] Others, like some members of the Lanarkshire Coal Masters' Association opted to be selective with their data.[87] Consequently, the level of strike activity in the Lanarkshire coalfield unearthed from the LCMA minute books, while greater than official or GLHW figures, most probably also understates the actual level of unrest.

TABLE 5.2 STRIKES IN LANARKSHIRE COALFIELD, 1910-1914.

	GLHW	LCMA
1910	3	10
1911	16	7
1912	8	4
1913	15	17
1914	11*	47
TOTAL	53	85

* Figure is for the first seven months only. National strike of 1912 not included.
Source: Data in first column from R.Duncan and A McIvor (eds) '*Militant Workers*' p 85. Strikes in second column from the Annual Reports of the Lanarkshire Coal Masters' Association, 1910-1914.

When the incidence of strikes in Lanarkshire is considered it can be seen that 1913 and 1914 were years of increased industrial conflict. This fact is borne out by both the frequency of strikes and the amount of compensation paid to members of the employers' association.[88] The actual number of stoppages that qualified for compensation payments has only been recorded for 1914. That year 27 coal companies received £11,611 for profits lost during 34 disputes.[89] It can also be seen that industrial unrest, in this sector of Scottish industry at any rate, was not stemmed by the outbreak of war. Over 25 percent of stoppages in 1914 took place after the outbreak of hostilities.

Closer inspection of strikes indicates the type of dispute was also changing in the later years. In the months following the national strike there is increasing reference in the LCMA's minute books to miners holding morning meetings and then taking the rest of the shift off. In 1912 these meetings were invariably about the presence of non-union labour. In order to combat this practice employers decided to impose a lock-out for a further two days.[90] This entitled member firms to receive compensation. It is difficult to calculate the total number of days lost from stoppages because the starting or finishing date of disputes is invariably missing from the LCMA's records. However, these dates are known for the 31 morning meetings which occurred during 1913 and 1914. Of this total 21 lasted for four or more days, and a few for as long as two weeks. These token strikes, Smillie argued at a meeting of the Conciliation Board in 1912, were in response to management reducing rates or making changes in methods of production without joint consultation with mineworkers, which was the traditional custom.[91] In essence the conflict can be seen as the right to manage versus traditional custom and practice. These stoppages were unofficial in nature, taken by the miners at the pithead - where notice of management changes were posted the night before. When employers changed their tactics and began to lock miners out the union became involved and in the majority of cases financially supported their members throughout, and beyond the lock-out , usually for a week. Therefore, the majority of morning meetings began as unofficial wild-cat action, became an employers' lock-out and ended as official strikes.

The Fight against Non-Unionism, Supervision and Contracting.

Before looking at the issues which lay behind this industrial unrest some explanation of the limitation of the sample from the LCMA's records is necessary. Although the data is quite explicit on the duration of stoppages classed as morning meetings it is much less reliable on the reasons behind them albeit, as is mentioned above, the main problem seemed to be one of control. Of the remaining 54 cases, where the cause of the strike is known for 51 stoppages, the main points of conflict were as follows; wage issues (generally opposition to wage reductions) accounted for 44 percent of stoppages. The next biggest area of discontent, responsible for 19 percent of strikes, arose over proposed changes to working conditions or work methods, that is, over control in the workplace. Victimisation of mineworkers and the presence of non-union members in the pits caused 13 percent and 11 percent of downtime respectively, with sympathetic strike action and opposition to the system of contracting in mining accounting for the remainder. It is clear then that wage and control issues were the focal point for much of the unrest.

A more in-depth investigation of some areas of discontent should prove instructive at this stage. The fight against non-unionism is one area where organised labour achieved significant success. One of several examples of this type of struggle was the dispute at the Summerlee Coal and Iron Company's

Bellshill mine in 1913. This strike, which had been an ongoing source of conflict since early 1912,[92] finally erupted in early January when 1,000 workers struck work over the company's continued refusal to deal with the problem. D Mowat, general manager of the Summerlee Co., stated 'that he would never compel men to join the union'.[93] This attitude ties in with the long anti-union tradition at Summerlee. Summerlee was one of the large concerns mentioned earlier which were forcing their workers to contract out of the Minimum Wage Act agreement. John Robertson, vice president of the Scottish Miners' Federation (SMF), was at Bellshill to negotiate but, true to form, Mowat refused to see him. Robertson then threatened to extend the dispute to other mines in the Summerlee group which could have resulted in 5,000 workers downing tools. The strike ended within a few days. Management conceded defeat and agreed that all non-union workers would be given four weeks to join the union. If they refused then the company would *deal* with them. Also any new workers would be made to join the Lanarkshire Miners' County Union as soon as possible. In effect the miners had won a closed-shop agreement, an extraordinary victory over such an anti-union employer.

Why had such a staunch, anti-union company capitulated over this issue in a matter of days? Rising demand for coal products was one factor which favoured labour in this period. Coal prices had been increasing since the summer of 1912 and rose even more sharply with the onset of winter. The Summerlee Company would have faced a large cut in profits if 5,000 miners had gone on strike. Also they could not rely on compensation payments from the employers' association to offset this loss as the LCMA had decided against recompensing members because some other companies within the association, and nationwide, had already conceded closed-shop agreements. Indeed, at national level 65 percent of disputes in mining and quarrying were settled in favour of workers in 1913 and as the following statement from the Report on

Strikes and Lock-outs for that year indicates the fight against non-unionism was a significant factor:

> The high proportion of disputes settled in favour of the workpeople in the mining and quarrying trades was mainly due to the success which attained strikes against the employment of non-unionists in the coal mining industry.[94]

Other examples of successful action against non-union labour in Lanarkshire pits in 1912-1913 include Summerlee mines at Braidhurst and Hattonrigg, Dixon's Carfin pit, Baird's Bedlay mine, the Kenmuirhill pit owned by the Glasgow Coal Company and Russell's Ferniegair mine.[95] These victories over one of the most draconian of all employers' organisations stem in part from the growing strength and organisation of coal miners and the increased militancy of many groups of workers in the period.

Organised labour made further inroads in the fight for control in the work place by forcing supervisors to join their union. The first tier in management in the mines was the fireman. As well as being responsible for safety in the pit firemen also allocated work to the men. These supervisors were the people mineworkers negotiated with over any problems concerning work in the pit. For example, in cases of deficient places workers would first negotiate with firemen over rates. Thus, to get this group of key workers to join the union was a significant achievement for organised labour. The majority of disputes over this issue happened in 1913 and 1914. For instance, strikes in early 1914 at Priory, Parkhead, Shotts and Baton collieries all resulted in firemen joining the LMCU. Perhaps the most telling case was at Russell's Ferniegair pit. Here a fireman refused to join the union. The ensuing strike was only settled when management sacked the supervisor in question.[96] The fact that some coal owners were forced to accept firemen joining the miners' union (and in the case of Ferniegair management played an active role in this process) again highlights the successful assault on managerial prerogatives by mining labour in this era.

Contracting in the mines was another bone of contention with colliers. This system of working saw owners subcontracting various sections of a mine or an entire pit to contractors. These middle-men in turn hired miners to carry out the work. Mineworkers were against this system for several reasons. Coal companies paid the contractor and, thus had no responsibility to ensure that colliers received the correct remuneration, or, indeed were paid at all. Robert Smillie stated at a meeting of the Conciliation Board in 1911, that during the last two decades he knew of 40 or 50 cases of contractors absconding with miners' wages.[97] Also when work was sub-divided between several contractors it proved difficult for union organisation. In effect union officials had to deal with several different employers of relatively small squads of workers which made union recruitment difficult. It was also relatively easy for contractors to get rid of union members and activists. Contracting appeared to be declining in the decade before the war. Indeed, in 1908, the LCMA declared that they had abandoned contracting for ordinary coal getting, that is hand-hewing of coal.[98] Despite this statement contracting lay behind numerous disputes during the period in question. One example occurred at the Blairmuckhill Colliery in early 1913 when management tried to re-introduce the practice. They tried again a year later. Other strikes occurred at Loganlea and Howmuir mines and at Kenmuirhill where management eventually agreed to abolish contracting, conceded a five day week and forced non-unionists to join the LMCU. The fight to end contracting was another area where the miners' union gained considerable success. However, labour opposition was not the sole prerogative of the county or national unions.

A particular feature of industrial unrest in this period was the high level of unofficial action instigated by rank and file workers. For instance, a strike at Earnock Colliery in July 1912, was started by men at the coalface when management refused an extra payment for working double shifts. The union later authorised this action and granted official support.[99] In July 1911, three pits at United Collieries, Nackerty mine in Uddingston, came out on strike over several grievances; contracting, the introduction of outside labour, victimisation and improved wages and conditions. Although not initiated by the rank and file, the stoppage was prolonged by activists who campaigned against the union's call to return to work pending negotiations.[100] The strike, involving approximately 600 workers, began on 29 July. The union executive called on the men to return a week later. A report in a local newspaper stated of the men:

> They have practically thrown down the glove to the local agent (Mr Murdoch) and the executive, demanding their dealing with the grievances on which they were brought out, and have sent the agent back to the executive with that message.[101]

This strike continued until November. Only a few of the LMCU executive minutes for 1911 have survived, therefore it is not known whether the union continued to pay strike money to the men. Whether this was the case or not for mineworkers to remain out for this length of time shows the depth of feeling on the issues in question and, perhaps more importantly, it highlights the growing opposition of rank and file members to the policies being pursued by the union hierarchy.

Indeed, in several instances pre-emptive action by the rank and file led to stoppages getting official union support. This, again being more likely in 1913-14. For example, in December 1913, mineworkers at Muiracre mine struck over a proposed wage reduction. This unofficial action later received union backing.

Another case occurred in May 1914, at Cadzow Colliery when a wild-cat strike by machinemen over tonnage rates resulted in other workers at the pit being locked out.[102] The union made the strike official and thus miners received strike pay whilst fighting the case. Similarly, at Newton Colliery rank and file action over firemen resigning from the county union also received official support.[103] However, not all unauthorised disputes gained official blessing. The case at Monklands pit in the summer of 1914 is a typical example. Twenty colliers had '*lifted their graith'*, - walked off the job, due to low wages. The LMCU in this instance refused to investigate the dispute until the miners returned to work.[104]

The case at Monklands is just one of many examples where trade union leadership clamped down on wild-cat action. Indeed, many potential stoppages were prevented by the union hierarchy opting to settle disputes through negotiations with employers, often reaching agreements which ignored the wishes of their membership.[105] The approach to industrial relations adopted by the LMCU supports J Zeitlin's hypothesis that union leaders, due to the nature of their agreements with management 'adopted an active role in sustaining managerial discipline in the factory',[106] or in this instance, the mine. The increasingly institutionalised structure of collective bargaining which was being pursued by union executives was a constant source of friction within the industry and led to increased independent action by rank and file members. The case of the Lanarkshire miners, at any rate, supports James Hinton's argument that the emergent system of collective bargaining in this period 'strained the relationship between trade union officials and their more militant workers'.[107]

However, other elements were also present which affected the high level of unrest. Intensification of work was also an important contributory factor. Coal mining, like many other sectors of British industry, was facing stiff competition from overseas producers. Colliery managements throughout the industry attempted to increase output through wage cuts, increased supervision, a greater move to mechanisation and a general speed-up in the pits. All these cost reducing methods created friction in the workplace and soured relations between management and mineworkers.

Arguably, two main sources of discontent in Lanarkshire were the implementation of the Eight Hours Act of 1908, and greater use of machine coal-cutters and mechanical conveyors underground. The Eight Hours Act resulted in mine managers increasing the tempo of work in an attempt to achieve the same production in an eight hours shift that had been gained previously in nine hours. Introduction of mechanical aids to boost production quotas generally resulted in changes to traditional work systems. Shift patterns were altered. For example, when coal-cutting machinery was introduced a move to a two shift or three shift system was seen as the most productive method of working. Under these new systems any delay to one part of the mechanised cycle would delay succeeding shifts. Mechanical breakdown of cutting or conveying equipment, which was a fairly regular occurrence, meant disruption to the work system and loss of output. When breakdowns occurred machinemen would be coerced to work longer than eight hours. This created friction in the workplace. In 1910, at the Broomfield mine seven miners were dismissed when they refused to work over the eight hours. This mine had recently introduced a face conveyor and this was at the root of the problem. The manager stated that, 'he could insist men at conveyors would be compelled to wait until their places were cleaned up, unless they did so, he would suspend them at his pleasure'.[108] Similarly, at Russell's Greenfield mine in 1913, machinemen were compelled to work 12 to 16 hours continuously.[109] These are just a few examples of this constant source of discontent in mining. Adding to this discontent was the fact that new shift systems also impinged on the mineworker's social life.

The LMCU were constantly at odds with mine management over the issue of long hours. Disputes frequently ended in strike action being taken. Union leaders also tried to solve this problem through official channels but with little success. Following a breech of the Act at Woodhall Colliery in December 1910, the union took the matter up with the Chief Inspector of Mines but to no avail.[110] (Indeed, it was 1935 before a special enquiry was held to investigate the problem of long hours within the Scottish coal industry). Also, following another infringement of the law at Auchengray pit, Longriggend, the LMCU brought the matter to the attention of the Police and Procurator Fiscal. However, the authorities, as noted in the LMCU's minute book, 'were diffident about raising a prosecution'.[111] The continual flouting of the Eight Hour Act was one factor ensuring relations between management and workers were strained. This tension between the two sides frequently erupted and resulted in strike action.

It was argued in chapter 3 that greater diffusion of mechanisation in Scottish pits meant traditional customs and practices of colliers were persistently threatened and that on balance new technology led to the division of labour and deskilling in pitwork. These changes to traditional work practices often resulted in disputes over control at the point of production - the right to manage versus traditional custom and practice. A dispute at Nimmo's Auchengray mine near Airdrie being a typical example. Miners working a section of the pit by traditional hand-hewing methods struck work over disputed tonnage rates. Management extended a nearby machine run into the disputed section. Colliers subsequently 'blocked' the whole section claiming that 'management had no right to take by machine any coal which had previously been wrought by pick'. Coalowners contested 'the right of the workmen to interfere with their right to say by what method the coal should be worked'[112] and in retaliation imposed a lockout. The employers' association viewed this dispute as a serious point of principle and thus Nimmo & Co., qualified for compensation.

Table 5.3 provides some statistical evidence that shows that a correlation appears to exist between high strike rates and pits that employed machine mining techniques. The table compares the number of strikes that occurred at pits using machine cutters to the total number of strikes in Lanarkshire mines during 1910 to 1914.

TABLE 5.3 FREQUENCY OF STRIKES IN MECHANISED MINES, LANARKSHIRE, 1910-1914.

	Strikes	Mechanised Mines
1910	10	6
1911	7	6
1912	4	1
1913	17	13
1914	47	32
TOTAL	85	58

Source: Annual Reports of the Lanarkshire Coal Masters' Association, 1910-1914. Number of strikes occurring at mines which were mechanised calculated by cross referencing data in LCMA minute books, which named pits on strike with pits designated as using coal cutters in the List of Mines, an annual Board of Trade publication.

Out of the total 68 percent of strikes happened in mines engaged in machine mining. Not all of the 58 strikes that took place in mechanised mines were directly linked to the use of machinery. Some for example, as shown above, stemmed from problems of contracting, non-unionism or indeed from disputes over wage rates. However, these issues were also present in mines that still relied on traditional hand methods to extract coal. Yet, in 1914, only 42 percent of mines in Lanarkshire used coal cutters. It is evident, therefore, that the level of industrial unrest was significantly higher in mechanised pits. It could be argued then, that changes and pressures, which went hand in hand with new were a significant ingredient of labour unrest in Lanarkshire pits. Mechanisation may not have been a direct cause of strikes but it did provide potential grievances, which may have then been translated into industrial conflict. It seems as though Supple's idea of 'a latent culture of anger', created by the introduction of new technology, may, indeed, be a factor behind the increase in militancy displayed by workers employed at mechanised pits in Scotland.[113]

Labour Unrest in the Lanarkshire Coalfield, 1932-1938.

The level of strike activity in the second period of investigation was lower than that witnessed in the turbulent years prior to World War One. The economic position of miners and the level of trade union membership in both periods were undoubtedly a major factor governing strike levels. During the earlier period mineworkers experienced improving economic conditions. From mid-1912 rising demand for coal in domestic and foreign markets saw wages and coal prices escalate. Daily wage rates stabilised at 7/3^{d} in 1913 and pit-head prices averaged 9/6^{d} per ton.[114] Tight labour markets led to an increase in trade union membership. The Scottish Miners' Federation, for example, witnessed a growth in members from 78,000 in 1912 to 90,000 in 1914.[115] This expansion in membership increased the bargaining position of mineworkers. The increase in industrial unrest in Lanarkshire pits undoubtedly reflected the efforts of miners to claw back ground lost in the preceding decade.

Mineworkers were in a similar position in the mid-thirties in that demand for coal products increased from late 1934 due, mainly to the revival of the iron and steel industry. Without doubt economic conditions during the slump of the early thirties were much worse than they had been in the earlier period. One outcome of the economic problems faced by the coal industry since the mid-twenties was a vastly reduced workforce. Employment in Scottish pits peaked at 141,400 in 1924. This figure had dwindled to 81,400 by 1933.[116] - a reduction of approximately one third. Union membership, on the other hand, had been reduced from 85 percent to 42 percent of those employed.[117] Added to this was the fact that the Scottish unions were plagued by internecine struggles. Thus, organised labour was in a much less favourable position to oppose coalowners. It is hardly surprising, then, that the level of unrest was lower in the twenties and thirties.

Table 5.4 shows the number of strikes that occurred at Lanarkshire pits between the years 1932-39. The annual List of Mines for the years 1932-35, and 1938 have been traced and by cross referencing the strikes with the data in the List of Mines it has been possible to determine the number of disputes which occurred at mechanised mines. All strikes recorded in table 5.4 for the years 1932-1935, and 1938 occurred at mechanised mines. That is, all labour unrest, as recorded by the LCMA, broke out in pits which practiced machine mining. Also, at least seven of the nine strikes in 1936, seven of the eleven stoppages in 1937 and thirteen of the sixteen strikes in 1939 took place at pits that were engaged in machine mining in the years before or immediately after these dates. That so much unrest broke out at pits where new extraction methods were employed is all the more revealing when it is recognised that in 1938 only 46 percent of mines in the Lanarkshire district were using mechanised mining methods.[118] This is a strong indication that the pressures produced by machine mining work systems resulted in a workforce which was much more liable to pursue militant action.

TABLE 5.4 FREQUENCY OF STRIKES IN LANARKSHIRE MINES, 1932-1939.

Year	No. of Strikes	Compensation
1932	4	not known
1933	5	not known
1934	2	£ 3,218
1935	6	£ 3,038
1936	9	£ 11,129
1937	11	£ 18,628
1938	14	£ 44,250
1939	16	£ 36,149
Total	67	£116,412

Source: LCMA Annual Reports and Minute Books, 1932-1939.

Table 5.4 also shows the amount of compensation paid by the association to members for profits lost during strikes which were deemed as being of general interest to the coal trade. The rising cost of such disputes indicates an increase in the number of stoppages and in the duration of disputes. The LCMA paid out £36,149 in compensation to members in 1939. However, it is noted in the annual report for that year that a large portion of this money was for a strike at Archibald Russell and Company's Polmaisie 3/4 colliery in 1938. Thus, the amount of compensation shown in the table for 1938, considerable though it was, should in fact have been much higher. It is apparent then, that 1938 was the year of the greatest industrial unrest in the county's coalfields in this later period.

J H Goldthorpe has argued that the switch to modern mining methods destroyed the traditional work systems underground. New working methods that were a necessary feature of machine mining required greater and stricter supervision in the pit. Miners working in pits where traditional hand-got methods of coal extraction were used were skilled craftsmen. Work units were small, often linked by kinship. John MacArthur and Bob Smith, for instance, both speak of starting in the pit working alongside their fathers.[119] Supervision in mines working this system was limited. The miners set their own pace and had practically complete autonomy when working at the face. The new system brought increased supervision. The number of officials below ground increased from 34 per 1,000 to 40 per 1,000 between 1905 and 1924.[120] A significant part of this increase was due to the introduction of a new strata of supervision – overmen. These supervisors introduced a stricter discipline in the mines, driving colliers at a much faster pace in the pursuit of increased output. It should come as no surprise, therefore, that colliers resented close supervision very strongly. Moreover, there was a traditional hatred of being 'stoodover'.[121] The move to a cycle system of working encroached upon the collier's control and autonomy at the coal face which led to an alienated work force. Mineworkers now found work routines were becoming increasingly regimented and a new type of discipline, 'a discipline imposed from above',[122] became commonplace in the pits. Goldthorpe contends that, 'a major cause of official stoppages was miners' resentment of what they considered to be arbitrary commands, such resentment is often at the root of strikes called for other reasons.[123]

Indeed, many of the stoppages that occurred in Lanarkshire at this time appear to have resulted from the colliers' reaction to increased discipline and control issues. For example, the cause of dispute is known for six of the eight strikes, which took place in 1934-35. One of these strikes, at Wm. Baird's Bothwell Castle mine in March 1935, concerned a breach of the seven and a half hour day act. The other five disputes were all the result of miners coming out in support of fellow workers who had been dismissed for various reasons. In one case, at Baird's Riddochhill colliery, 250 miners struck in support of four fellow workers who had been sacked for complaining about safety conditions in the pit. Another stoppage, involving nearly 700 mineworkers and again at the Bothwell Castle mine, centred on the dismissal of two men for fighting. Timekeeping was an issue that frequently resulted in the dismissal of workers and was just as frequently a cause of sympathy strikes in the pits. For example, at United Collieries Loganlea mine in October 1934, 650 mineworkers *'lifted their graith'* in protest after one of their number was sacked for *'jouking oot'* - leaving the pit early without permission.[124] Under the old system of mining this would not have been classed as such a serious offence. The hand-hewing miner having more control of operations and having made his '*darg*,' or daily quota, could have left work early causing little or no disruption to his fellow workers. Where modern mining methods were in operation, however, the absence of one or two workers could disrupt the work process causing significant delays. Industrial unrest of this nature is indicative of the miners' reaction to stricter discipline and their continuing loss of control in the workplace. The fact that all the identified strikes in this period occurred at mechanised pits supports Goldthorpe's argument, thus the introduction of machine technology and concomitant change in working practices produced the potential for increased militancy and deteriorated labour relations within the industry.

Closer investigation of the mines witnessing unrest during the years 1932-1939 reveals that with the exception of the stoppages at the Hirst Coal Company's South Blair mine in 1932, (workforce 88) and the Haywood Coal Company's Chapel Colliery at Newmains in 1938, (workforce 42) all other disputes occurred at pits employing more than 200 miners. Indeed, the vast majority of strikes happened at pits employing, on average 500 colliers. A few, the

Coltness Iron Company's Kingshill Number 1 mine in 1933 and James Dunlop's Cardowan Colliery in 1938 employed over 1,000 mineworkers - two of the largest pits in Lanarkshire.

TABLE 5.5 SIZE OF MINE BY LABOUR FORCE, LANARKSHIRE, 1938.

Lab/force	No. of mines	% using machinery
1-9	40	0
9-49	56	46
50-99	9	44
100-499	43	98
500-999	16	100
1000-1999	3	100

Source: Annual List of Mines, 1938.

Table 5.5 depicts the size of mines in terms of labour force in 1938. It can be seen that the Lanarkshire district had many small pits, that is those employing fewer than 50 workers. Indeed 96 mines, or 57 percent of the total, were in this category. The Scottish average for mines employing less than 50 miners was just under 45 percent.[125] Mines employing less than ten workers relied on traditional hand-hewing extraction methods. In pits with a labour force of between 10 to 49 workers, the biggest category in the county, less than half, 26 out of 56, are recorded as using machine cutters.[126] Only one strike, at Haywood's Chapel Colliery, occurred at a mine employing less than 50 workers. This mine is recorded as using coal cutting machines in that period. Thus, it is fair to say that industrial unrest in pits of this size was conspicuous by its absence. This evidences again supports Goldthorpe's argument that the switch to modern mining practices alienated workers and led to increased trouble between labour and mine management.

Evidence from other coal mining districts display similar findings. The Ayrshire district was another area that witnessed troubled labour relations during this period. Table 5.6 has been compiled after a thorough search of the minutes books of the Ayrshire Miners' Union. It can be seen that 121 disputes occurred between 1932-1938. Of these disputes 93, or 77 percent took place at mines which were engaged in machine mining.[127] Data in table 2.3.7 shows that slightly less than two thirds of pits in Ayrshire were mechanised by 1938. Moreover, between 1932 and 1938 this coal field, as can be seen from column three in the table, witnessed a rapid rate of mechanisation, growing from 47 percent of mines using coal cutters at the earlier date to 64 percent in 1938. Furthermore, as with the case in Lanarkshire, disputes in Ayrshire pits were more likely to occur at mines with a relatively large workforce.[128] Thus, a positive correlation seems to exist between high levels of labour unrest and mines that had adopted mechanised mining techniques.

TABLE 5.6 NUMBER OF DISPUTES, AYRSHIRE COAL FIELD, 1932-1938

Year	No. Disputes	No. at Mechanised Mines	% Mines using Machines
1932	11	8	47
1933	30	21	52
1934	17	14	58
1935	16	13	57
1936	11	7	58
1937	13	9	68
1938	23	21	64
Total	121	93	

Source: Ayrshire Miners' Union Minute Books, 1932-1938, List of Mines, 1932-1935, 1938, column 3 showing county average level of mechanisation taken from table 2.3.7.

As to the causes which lay behind unrest in Ayrshire pits the issue of wages, again usually concerning a reduction in wages, was the most common cause of dispute in the 1930s. This issue accounted for 66 percent of all stoppages in the period. Many of these, it should be noted, were directly related to mechanisation. For instance, in 1932 three of the eleven disputes recorded for that year were connected with tonnage rates in newly opened pan-runs (face-conveyor runs). Two of these disputes occurred at the Annbank colliery and one at Mossblown. Failure to agree at the Mossblown pit resulted in the pan-run being abandoned. Whereas, at the Annbank mine the company proposed a payment of one shilling per ton but expected the fillers to pay the worker at the load-end out of this payment.[129] (End of pan conveyor where the coal is transferred to haulage tubs, or in more modern set-ups, another conveyor which took the coal to the pit bottom). Another dispute over tonnage rates in a machine-run at the Annbank colliery in 1936 was settled when the miners were successful in gaining an increased offer.[130] Trouble at the Littlemill mine in 1938 stemmed from a machinery breakdown. Due to the delay caused by a coal-cutter malfunctioning coal cuttermen were asked to work over their normal shift to strip coal without overtime rates. They succeeded in getting an overtime payment, as did the strippers who had been forced to wait in the pit until repairs were affected.[131] These examples show how new technology brought completely new work and payment systems along with new extraction methods and it was the grievances created by these changes to traditional work practices which lay behind some of the unrest in the Scottish coalmining districts.

Like the period before the Great War, non-unionism and contracting were still a source of friction in the pits. Indeed, these issues accounted for 11 percent of stoppages in the Ayrshire mines in this period. In this instance, however, non-unionism disputes referred to clashes between members of the Ayrshire Miners'

Union and men who were members of the United Mineworkers of Scotland, not workers who did not have union membership.[132] Disputes that originated from disciplinary/unfair dismissal issues also account for a significant proportion of disputes. One eighth of all stoppages came under this heading. The frequency of such disputes reflects the tightening-up of discipline in the pits - a characteristic of the new work system. Disputes over time keeping also appear frequently in the Ayrshire union's records and once more indicate how discipline in the industry had become much stricter. For example, in 1934 management at Annbank Colliery sacked a boy who had missed a shift because he had been a witness in a court case.[133] The following year workers at the Muirkirk pit were in dispute with management over the length of their meal breaks.[134] These issues are a further manifestation of how the diffusion of new technology and the need to adhere to strict pre-determined work schedules led to conflict in the industry as mineworkers fought to maintain their hold on traditional custom and practice.

Conclusion

What then has this investigation on the impact of mechanised mining practices upon labour relations in the Scottish coal industry established? The allegation that labour adopted an obscurantist and obstructive stance to the introduction of new technology to industry has, in the case of Scottish mining labour, been disproved. Statistics, both as regards the level of mechanisation in Scottish pits and for the tonnage cut and transported underground, shows the diffusion of machine mining techniques continued steadily throughout the period 1890-1939. Thus, Scottish miners did not prevent the spread of new technology within the industry. Regarding the theory that the support of mining labour for technological change was gained through enhanced earning power it has been shown that machinemen did not necessarily earn more than hand-hewers. Indeed, evidence has been provided which confirms that some cuttermen actually earned less when working under the new system. One reason for the lack of resistance to change was the *ad hoc* way in which new technology was introduced to the Scottish coal industry. This, the author would argue, has certain validity when one considers change taking place over a relatively short time period. However, the force of this argument is dissipated somewhat when applied to a period of half a century. A more persuasive contention is that Scottish mining labour was in such a weakened state that opposition to change was impossible. This was the case with Scottish mining unions for much of the inter-war years and this may well account for the apparent ease with which new mining methods were introduced. In other words, Scottish mineworkers did not have the capacity to mount a sustained challenge to the changes that were occurring to their industry. However, doubt also exists as to whether Scottish miners had the will to oppose change. Lack of grass-root organisation might account for the absence of opposition to new technology but it does not explain why Scottish colliers were seen by Masterton, Reis and Muir as being cooperative, indeed, vital to the success of the new production methods.

It is clear that mining unions at executive level were in favour of and supported the extension of new technology within the industry. National leaders such as; Smillie in 1919, Edwards in 1931 and Jones in 1938 all gave their full support to the mechanisation of coal production. Was this attitude typical throughout the industry? Many examples of independent rank and file action have been highlighted in the study and many of these have been connected with mechanisation. Yet, the fact that colliers with "hands-on" experience of machine mining chose to strike over tonnage rates in machine-runs does not mean these workers were Luddite. It merely shows that these miners disagreed with the proposed level of remuneration that mine owners and, on occasion the union leadership, thought appropriate for working under new conditions.

The case studies of the Lanarkshire district and the Ayrshire coalfield reveal that many different reasons existed for the level of unrest in the 1910-1914 and 1932-1938 periods. Wage issues accounted for much of the conflict in both eras. The presence of non-union labour (non-NUSMW affiliated labour in the 1930s), was also a source of much unrest in both periods. The impact of mechanisation on the industry has been shown as having a significant effect on industrial relations. Statistical evidence has shown that a link existed between mechanisation and high levels of industrial unrest in the Scottish coalfields. In both periods and in both the Lanarkshire and Ayrshire coalfields stoppages were much more likely to occur at pits where machine mining methods were in operation than in those which still relied on traditional hand-hewing techniques.

What reasons lay behind the high level of conflict in mines which had adopted new cutting and conveying technology? It has been shown in a previous chapter that the switch to modern extraction techniques led to an intensification of work in the mines.[135] The combination of longer hours, speed-up, the division of labour, and being paced by machinery provided the necessary ingredients that ensured conflict in mechanised Scottish pits was never far from the surface. The diffusion of coal-cutters and conveyors heralded new working systems. Modern mining methods invariably meant a move to longwall mining where miners worked in larger groups with increased supervision and stricter working regimes. Larger numbers of supervisory staff meant that mine owners and managers spent less time below ground which reduced the amount of face to face contact between miners and management thus lessening the chance of quick resolution of workers grievances. Indeed, the new system of working forced miners to take their complaints to the union representative, thus formalising industrial relations.[136] Moreover, working in larger groups in longwall mechanised mining provided a greater opportunity for the spread of shared grievances that would have a detrimental effect on labour relations. Furthermore, it has been demonstrated that a common feature of unrest in mechanised mines in Lanarkshire and Ayrshire was that it invariably took place at mines employing large numbers of workers which would have facilitated this spread of shared grievances.[137]

It is not the intention of this thesis to portray the mechanisation of Scotland's coal industry as a monocausal explanation of the high level of industrial unrest in Scottish pits during the 1890-1939 period. However, the study has shown that the move to machine cutting and mechanical conveying did produce a number of potential grievances for Scottish colliers. Whether these were then translated into industrial unrest, however, depended upon a wide range of variables. Included among these were institutional factors such as the tradition of collective bargaining, the capacity for communal mobilisation and the role and political activities of left wing groups, the Communist Party, for instance. Furthermore, Church *et al* has shown that some coalmines were more strike-prone that others. Indeed, for the years 1936-1940 he shows that of the nine most strike-prone collieries in Britain eight were in the West Central coalfield of Scotland.[138] This suggests that while some mechanised pits witnessed a high level of strike activity others would have experienced little, or no unrest. Campbell's work on the political history of Scottish coalfields highlights the role played by Communist Party activists in some Scottish pits. He cites, for example, that James McKendrick became the secretary of Blantyre's Priory branch in 1935. This was the branch for the Bothwell Castle numbers 3 and 4 pits one of the most strike-prone pits in Britain at that time.[139] Campbell states, 'the Communists did indeed seek to seize the leadership of such strikes, (increasing sectional and lightening strikes) although they can scarcely be credited with the conditions which gave rise to them'.[140] Therefore, although it has been demonstrated that left wing activists played an important role in mobilising and leading strikes in some Scottish pits they did so by capitalising on grievances, which were already present within the mines. It is the contention of this investigation that the switch to mechanised mining practices was a significant initiator of such grievances. Thus, it can be argued that the mechanisation of Scotland's coalmines produced the potential for industrial conflict. That being the case, Church's assertion that 'mechanisation and its effects on work organisation were not central to changes in industrial relations'[141] needs to be re-evaluated. The findings of this study support the idea that mechanisation tended to inculcate a 'latent culture of anger' within the pits. This helped ensure that industrial relations in some mechanised mines in the Scottish coal industry remained volatile and that these pits witnessed a higher level of industrial unrest than those which relied on traditional methods of coalmining.

Notes for Chapter 5.

[1]J H Goldthorpe, 'Technical Organisation as a Factor in Supervisor-Worker Conflict', *British Journal of Sociology*, [*BJS*] Vol X, No. 3, (1959), pp 213-230.
[2]D S Landes, *The Unbound Prometheus*, (1989), D H Aldcroft and H W Richardson, *The British Economy, 1870-1939*, (1969),
[3]B Elbaum and W Lazonick, 'The Decline of the British Economy: an Institutional Perspective', *Journal of Economic History*,[*JEH*], 44(2) (June 1984) pp 572 & 573.
[4]Ibid, pp 572 & 573. Also see W A Lewchuk, 'The Role of the British Government in the Spread of Scientific Management and Fordism in the Inter-War Years', *JEH*, 44 (2) (June 1984) p 360.
[5]H F Bulman, *Coalmining and the Coal Miner*, (1920), p 47.
[6]*Report of the Miner's Eight Hour Day Committee,* Part III, (B P P) 1907, (Cd 3428), Q1147, evidence of G A Mitchell of Kerr and Mitchell, director of the Lochgelly Iron and Coal Company Ltd., and president of the MAGB, 1906-1907.
[7]Ibid, Q1754, evidence of Henry Mungall, chairman of United Collieries Ltd.,
[8]*Colliery Guardian*, Vol LXXIX, 1 June 1900, pp 1028, 1029.
[9]A J Taylor, 'Labour Productivity and Technical Innovation in the British Coal Industry, 1850-1914', *Economic History Review*, (*EHR*) Vol 14, 1961, p 59.
[10]D C Coleman and C McLeod, 'Attitudes to New Techniques: British Businessmen 1800-1950', *EHR*, Vol 39 (1986), p 606. M W Kirkby, *The British Coalmining Industry, 1870-1946*, (1977), p 189, M A Walter The Coalminer this Century: Social and Economic Relationships in the Light of the Changing Labour Process, Keele University M A Thesis, 1982.
[11]F Zweig, *Men in the Pits*, Left Book Club edition, (1948), p 151.
[12]G L Kerr, *Practical Coal Mining*, (1914), p 134.
[13]*Colliery Guardian*, Vol LXXXV 20 February, 1903, Paper entitled *Notes on Coal-Cutting Machinery*, p 410.
[14]A Campbell, 'Colliery Mechanisation and the Lanarkshire Mines', *Society for the Study of Labour History. (Bulletin)* 49, (August 1984,) p 41.
[15]*Report of the Miner's Eight Hour Day Committee,* Part III, (B P P) 1907, (Cd 3428), Q1147, Q1148, evidence of G A Mitchell and H Mungall, Q1755.
[16]*Colliery Guardian*, Vol XCVII, 21 May, 1909, Article titled *Trade Unions and Coal Cutting Machinery*, p 1029.
[17]National Library of Scotland, [NLS], Scottish Miners' Federation, Minute book, Executive meeting, 31 October, 1904, ACC 4312.20.
[18]Glasgow University Archives, [GUA], Lanarkshire Coal Masters' Association, Minute book UGD/169/1/14, Joint meeting LMCA and LCMU 15 August 1921, p 2.
[19]Ibid, p 5.
[20]NLS, LCMU, Minute books, executive meeting, 23 October, 1907, DEP 227.51.
[21]*Colliery Guardian*, Vol XCIX, 14 January 1910, pp 70-71.
[22]See below for fuller discussion on the threatened strike of 1909, pp 211-215.

[23]See chapter 3, p 138-139, for more on this.
[24]J L Carver, *Fifty Years of Machine Mining Progress*, (Motherwell, 1949), p 32.
[25]A Campbell, *SSLH*, p 41.
[26]B Supple, *The History of the British Coal Industry, Vol 4, 1913-1946*, (Oxford, 1987), pp 438 & 439.
[27]*Colliery Guardian*, Vol CXVIII, 18 July, 1919, p 164.
[28]Ibid, Vol CXLIII, 24 July, 1931, p 307.
[29]Margot Heinemann, *Britain's Coal: A Study of the Mining Crisis,* (1944), pp 26-32.
[30]MLG, LMCU, Executive Committee Minutes, 31 January 1928, pp 43, TU 331.88122 Lan,
[31]Ibid, pp 37, 49, 70.
[32]*Colliery Guardian*, Vol CLVII, 22 July, 1938 p 170.
[33]Ibid, Vol CXXXV, 16 December 1927, p 1519.
[34]Inspector of Mines Report, Scottish Division, 1928, p 9.
[35]A Muir, *The Fife Coal Company Ltd; A Short History*, (Cambridge, 1954), p 39.
[36]*Colliery Guardian*, Vol CXXXV, 16 December 1927, p 1519.
[37]Ibid, Vol CL, 1 February 1935, pp 210, 211.
[38]Figure for British union densities taken from G Bain and R Price, *Profiles of Union Growth*, Table 2, pp 45 (Oxford 1980). The Scottish figure calculated from employment figures as shown in Table 2.3.3 p 90 and from union membership as stated at the annual conference of the National Union of Scottish Mine Workers, July, 1935, p 14, PDL/45/7, NLS.
[39]S Renfrew, Militant Miners? Strike activity and industrial relations in the Lanarkshire coalfield, 1910-1914, in W Kenefick & A J McIvor (eds), *The Roots of Red Clydeside, 1910-1914, Labour Unrest and Industrial Relations in West Scotland*, (Glasgow, 1996). This section on labour unrest draws heavily on the author's chapter in this book.
[40]A Campbell, *The Lanarkshire Miners, A Social History of their Trade Unions, 1775-1874*, (Glasgow, 1979).
[41]R Page-Arnot, *History of the Scottish Miners from the Earliest Times*, (1955), pp 99-100.
[42]Ibid, table facing page 110.
[43]Ibid, p 121.
[44]MLG, MFGB, Annual Proceedings, 1912, Executive Committee meeting, 25 February 1912.
[45]*Forward*, 6 April, 1912. Interview of R Smillie by Patrick Dollan.
[46]MLG, MFGB, Annual Proceedings, 1912, Special Conference, 6 April, 1912.
[47]MLG, MFGB, Annual Proceedings, Special Conference on the Minimum Wage, Blackpool, 15/16 August, 1912.
[48]R Page-Arnot, *History of the Scottish Miners*, p 131 & 132.
[49]MLG, MFGB, Annual Proceedings, 1912, Special Conference, 6 April, 1912.

[50]R Page Arnot, *History of the Scottish Miners,* pp 67-70. Although the SMNF only survived for two years it was instrumental in stimulating the growth of county unions. Other Scottish national unions were; The Scottish Miner's Federation,(SMF), 1894-1914 which became the National Union of Scottish Mine Workers, (NUSMW), 1914-1945. In 1945 the NUSMW became the National Union of Mineworkers, (NUM), Scottish area.

[51]The "Block System" was where miners, when in dispute would block their fellow workers from working in the disputed area of a mine, or the mine itself or, indeed, a group of mines. Coal owners could also use their own version of the block by imposing a lock out or by refusing to employ miners who were locked out by another coal master.

[52]GUA, LCMA, Annual Report, 1887-1918, UGD/159/2/1, p 1.

[53]Ibid, p 2.

[54]Ibid, p 7.

[55]GUA, LCMA, Minutes, 9 and 14 August, 1893, UGD/159/1/2.

[56]GUA, LCMA, Minutes, special Executive Meeting 13 April, 1898, UGD/159/1/3.

[57]GUA, LCMA, Minutes, and A G M, 8 and 20 February, 1896, UGD/159/1/3.

[58]List of Mines, 1896.

[59]Church, *History*, p 666.

[60]*Colliery Guardian*, Vol LXVIII, 6 July, 1894, p 21.

[61]GUA, LCMA, Minutes, 5 October, 1894, UGD/159/1/2.

[62]GUA, LCMA, Minutes, A G M, 27 February, 1907, UGD/159/1/6.

[63]GUA, LCMA, Minutes, 27 February, 1901, UGD/154/1/5.

[64]List of Mines, 1914.

[65]GUA, LCMA, Minutes, 22 May, 1907, UGD/159/1/6.

[66]SRO, LCMA, Annual Reports and Balance Sheets, 1909-1946, CB.8/3.

[67]GUA, LCMA, Minutes, Executive Meeting 25 August, 1907, UGD/159/1/6. At a meeting on 6 January, 1908 it is noted that Wm. Baird and Company Ltd., enrolled 8 mines in the Stirling district and Robert Addie and Sons Ltd., enrolled their Herbertshire Colliery, also in Stirlingshire, in the LCMA.

[68]See Table 2.2.3, p 75.

[69]GUA, LCMA, Minutes, 5 September, 1893, UGD/159/1/2.

[70]Ibid, 17 June, 1896, UGD/159/1/3.

[71]Ibid, 23 March, 1898, UGD/159/1/3.

[72]Ibid, 20 October, 1897. UGD/159/1/3.

[73]Ibid, 1 August, 1900, UGD/159/1/5.

[74]Ibid, 20 January, 1904, UGD/159/1/5.

[75]Ibid, 11 December, 1912, UGD/159/1/8.

[76]Ibid, 9 March, 1899, UGD/159/1/3.

[77]See p 255.

[78]Church, *History*, Calculated from data in Table 8.1, pp 690-691.

[79]GUA, LCMA, Minutes, 11 December, 1912, UGD/159/1/8, and the List of Mines, 1912.

[80]J R Raynes, *Coal and its Conflicts*, (1928), p 87.

[81]GUA, LCMA, Minutes, 18 May, 1900, UGD/159/1/4.
[82]See pp 211-215.
[83]Ibid, 8 April, 1910, UGD/159/1/7.
[84]Ibid, 31 August, 1910, UGD/159/1/7.
[85]R Duncan & A McIvor, (eds), *Militant Workers*, (Glasgow, 1991), Table 3, p 85.
[86]W Kenefick, The Labour Unrest of 1910 to 1914, with particular reference to the Ardrossan Dock Strike, 1912-1913, University of Strathclyde, unpublished Honours Dissertation, 1990, pp 74 & 81.
[87]GUA, LCMA, Board Minutes, 1909 to 1910, UGD/159/1/7, Executive meeting of November, 1910, J M Strain of John Watson ltd., chairman of the LCMA, stated that members should supply the B.o.T. with the information in case the government made it compulsory. He added that his company only gives information on the important strikes.
[88]See table 5.1, p 222.
[89]GUA, LCMA, Annual Report, 1914, UGD/159/2/1.
[90]GUA, LCMA, Minute Book, 1911-1912, UGD/159/1/8. Strategy proposed by J M Strain, John Watson Ltd., at an executive meeting, 11 December 1912, as a way of eradicating the "idle - day" practice.
[91]GUA, Board of Conciliation Minutes, UGD/160//1/1, 2 August, 1912
[92]*Daily Record*, 7 January 1913, p 3.
[93]*Glasgow Herald*, 8 January, 1913, p 9. Mowat also claimed at a strike committee meeting of the LCMA that if the men were not forced to join the union then 30% of them would be outside the union.
[94]*Report on Strikes and Lock-outs and on Conciliation and Arbitration Boards,* 1913, (B P P) (Cd 7658), pp xx & xxi
[95]*Glasgow Herald*, July, September and October 1912, October 1913, and NLS, Lanarkshire Miners' County Union (LMCU), Minute Book, 13 January, 1913 - 22 December, 1913, DEP 227.52.
[96]NLS, LMCU, Minute Book, DEP 227.56, Executive committee meeting, 21 March, 1914.
[97]GUA, Board of Conciliation Minutes, UGD/160//1/1, 13 March, 1911.
[98]GUA, LCMA, Minute Book, 1908, UGD/159/1/6, Executive Committee meeting 4 March, 1908. Association declares they have stopped contracting for ordinary working but not for machine cutting.
[99] *Airdrie and Coatbridge Advertiser*, 6 July, 1912, p 6.
[100] *Glasgow Herald*, 29 July, 1911 to 10 November, 1911.
[101] *Motherwell Times*, 11 August, 1911, p 3.
[102]NLS, LMCU, Minute Book, Executive meeting, 5 May, 1914, DEP 227.56.
[103]Ibid, Executive meeting, 9 May, 1914. In this instance action by mineworkers proved successful, the firemen re-joining the union shortly after the stoppage began.
[104]Ibid, Executive meeting, 10 June, 1914,
[105]GUA, LCMA, Annual Report, 1914, UGD/159/2/1. Note that a number of disputes had been settled by joint conferences with the miners' representatives, thus saving on compensation payments.

[106]J Zeitlin, 'Rank and filism in British Labour History: a critique', *International Review of Social History*, [*IRSH*], Vol 34, (1), (1989), p 46.
[107]J Hinton, *Labour and Socialism, a History of the British Labour Movement, 1867-1974*, second edition, (Sussex, 1986), p 93.
[108]NLS, LMCU, Minute Book, Executive Meeting, 2 August, 1910. DEP 227.53.
[109]NLS, LMCU, Minute Book, Executive Meeting, 16 August, 1913. DEP 227.55. It should be noted that action against being coerced to work longer than the eight hour shift is not confined to the 1909-1914 era nor to Lanarkshire. The records of the Fife and Kinross Miners' Association are replete with examples of this type of issue. Miners in this coalfield had achieved the eight hour day in 1871. Their records make numerous references to disputes arising from miners working longer shifts. The frequency of such references, however, increases as machine mining becomes more common in the district after the turn of the century. For further information see NLS, Fife and Kinross Miners' Association, PDL 44/14, and DEP.304.1-3.
[110]NLS, LMCU, Minute Book, Executive Meeting, 7 December, 1910. DEP 227.53.
[111]NLS, LMCU, Minute Book, Executive Meeting, 13 December, 1913. DEP 227.56.
[112]GUA, LCMA, Minute Book, District Committee meeting, 5 August, 1914, UGD/159/1/9.
[113]B Supple, *History,* p 218.
[114]Page-Arnot, *History of the Scottish Miners*, wage and pit-head price of coal taken from table facing page 110
[115]Ibid, p 133.
[116]See table 2.3.3, p 90.
[117]See note 38
[118]See table 2.3.6, p 97.
[119]B Smith, *Seven Steps in the Dark: A Miner's Life*, (Barr, Ayrshire, 1991), McDougall, *Militant Miners*, 1981.
[120]*Royal Commission on Safety in Coal Mines,* 1936, (B P P), (Cmd 5890), table 3, p 51.
[121]Goldthorpe, *BJS*, Vol X, No. 3, (1959), p 215.
[122]Ibid, p 219.
[123]Ibid, p 223.
[124]All examples in this paragraph are taken from the LCMA's Minute Book No. 18, GUA, UGD/159/18.
[125]See Table 2.3.3, p 90.
[126]*List of Mines*, 1938.
[127]The figures for the years 1936-1937 are subject to the same limitations as those in table 5.4, p 238, in that the List of Mines has not been traced for these years. Thus, the mines noted as using machine mining techniques have been so listed if they were found to have been using machine cutters in the years 1935 and 1938.

[128]There is a problem identifying some of the mines in the Ayrshire district in the List of Mines which is the source used to determine the size of the workforce at individual coal pits. The names of several mines noted in the minutes of the AMU cannot be found in the List of Mines. It is probable that these names are local names for mines. However, of the 121 disputes recorded in table 5.6 it is known that 78 of these took place at pits employing 50 or more workers, indeed the majority occurred at pits with in excess of 200 workers. Only 4 disputes happened at mines that it is known for certain employed less than fifty workers. The county average in 1938 for mines employing more that 50 workers was 61 percent. Sixty four percent of disputes in table 5.6 occurred at pits with 50 or more workers but it is highly likely that this figure would be much higher if the remaining 39 mines could be traced.
[129]NLS, Ayrshire Miners' Union, Minute book, Executive meetings between February and August, 1932, DEP 258.2
[130]Ibid, executive meeting, 26 December, 36, DEP 258.3.
[131]Ibid, Executive meeting, 7 April, 38, DEP 258.3.
[132]Ibid, examples include Dallars Colliery, Hurlford, the Barony Colliery and the Highhouse mine in 1932, the Wellington Colliery in 1934, Old Cummunock mine in 1935, Annbank in 1936, and the Whitehill mine in 1937. This selection of examples taken from executive meetings between 1932-1938, DEP 258.1-258.3.
[133]Ibid, Executive meeting, 1 December, 1934, DEP 258.2. It is noted in the minute books that the lad was later re-instated following the intervention of the union.
[134]Ibid, Executive meeting, 6 April, 1935, DEP 258.2.
[135]See chapter 3, section on intensification and speed-up brought about through the move to mechanised mining, pp 112-117.
[136]*Colliery Guardian*, Vol CIIII, 16 February 1912, p 326.
[137]The same was almost certainly true for the others coalfields in Scotland, remembering that Fifeshire, for instance, was home to some of the biggest mines in Scotland.
[138] R Church, Q Outram & D Smith, British Coal Mining Strikes 1893-1940: Dimensions, Distribution and Persistence, *BJIR*, Vol 28, 3, (1990), table 5, p 343.
[139] A Campbell, N Fishman &D Howell, (eds), *Miners, Unions and Politics 1910-1947*, (Aldershot, 1996), p 166
[140] Ibid, p 167.
[141] R Church, 'Employers, trade unions and the state', in G D Feldman and K Tenfelde, (eds), *Workers, Owners and Politics in Coalmining: an international comparison*, (Oxford, 1990), p 16.

CHAPTER 6

Conclusions.

This study of the impact of mechanisation of coal production in Scottish mines during the period 1890-1939 has revealed the following facts. In the case of Scottish coalowners it has been shown that they do not fit the scenario as painted by Elbaum and Lazonick. Case-studies on several Scottish coal companies, for example, the Fife Coal Company Ltd., and the Lochgelly Iron and Coal company in Fifeshire and Wm. Baird and Company in the western coalfields have depicted businessmen at the helm of these firms as being among the pace-setters within the British coal industry when modernisation of mining methods is considered. Scottish coal companies had a higher level of industrial concentration than coal producers elsewhere in Britain. The Fife companies in particular displayed a very positive outlook to the adoption of new technology and work organisation in coal extraction.

The study has also demonstrated that Scotland's lead in mechanised production was not the result, as much of the existing literature purports, of the diminishing returns due to the depletion of her thicker coal seams. The prime-movers in machine mining were the coal owners in the eastern districts, Edinburgh and Fife, where the industry was developing and expanding not where it was contracting. This is not to deny that some Scottish coal companies adopted new cutting technology to work thinning seams. This did happen, particularly in Lanarkshire. However, as has been shown in chapter one if this had been the main reason behind Scotland's earlier adoption of mechanisation then one would have expected the proportion of coal cut from thin seams, those measuring 24 inches and below, to have increased throughout the period. This was not the case. In fact the opposite was true. The percentage of coal cut from such seams declined, whereas coal from 6 foot seams and above increased.[1] The findings show, therefore, evidence of progressive businessmen at the cutting edge of technological change who were willing to invest in new work methods. These were not the actions of coalowners who had been forced to adopt new methods as a last resort.

The move to mechanised production methods in Scottish pits brought with it revolutionary changes to work and workers in the industry. New technology necessitated radical changes to organisation and systems of work in Scottish mines. Production had to be organised around shift systems which impinged upon the control miners held at the point of production. Supervision intensified and became more widespread. Miners were forced to work longer hours, engaged in work which had become much more physically burdensome and psychologically stressful due, in great part, to the pacing effect machinery had on mining operations. The move to cutting and conveying by machinery allowed mine owners and their managements to erode the traditional custom and practice in Scottish mines and, so gain greater control over production. In light of these facts businessmen, in the Scottish coal industry at any rate, achieved significant success in gaining the right to manage their industry - contrary to the general criticism of British entrepreneurs by Elbaum and Lazonick.

Regarding the hypothesis that new technology had a deskilling effect on workers the case of the Scottish mineworkers has produced evidence which is somewhat conflicting. Some miners, those who worked machine cutters, were regarded as maintaining, if not increasing their skill level and status within the industry. However, for the vast majority of Scottish pitmen mechanisation reduced them to little more than manual labourers. At the outbreak of the second world war a significant percentage of workers in Scottish coalfields had skill levels which bore little resemblance to the all round 'superior men' of the

1890s. Thus, while some workers gained new skills and enhanced status from new technology the majority suffered a downgrading in status which indicates that the views of the pessimistic school, Friedman and Braverman for example, are more applicable to the fate of Scottish colliers.

The relationship between technology and employment is complex. In the earlier period of mechanisation it has been proven statistically that the adoption of machine coal cutting techniques created job opportunities for Scottish miners. The evidence from the eastern coalfield, in particular, substantiates this claim. This changed drastically in the inter-war period. Although a period of extreme economic dislocation and high unemployment for many British industries the evidence clearly demonstrates that some Scottish mineworkers witnessed higher than average levels of unemployment. This was particularly true in the Fife and Lanarkshire coalfields which had adopted underground conveyors to a much greater extent than the other coal mining districts. Once more statistical evidence sustains the link between mechanisation and employment, in this instance high unemployment. Thus, when employment in the Scottish coal sector is considered mechanisation proved to be a double-edged sword. One which, on balance, was to prove maleficent for Scottish miners.

Overall the impact of new technology in the Scottish coal industry had a negative effect on work and the workers. For the vast majority of workers mechanisation increased the burden of work because of intensification and speed-up, and led to a downgrading in status through deskilling and specialisation. After an initial boom in job opportunities many Scottish mineworkers increasingly faced a higher risk of unemployment and saw their control over production in the pits dwindle as mechanisation gradually transferred power to management and owners.

Looking at the relationship between mechanisation and health and safety in the Scottish coal industry or, indeed in British mining, it has to be emphasised that this is one area where little previous research has been conducted. However, investigation of various contemporary material has found that arguments abound on the possible benefits and drawbacks of modern mining techniques to the safety of mineworkers. It had been thought that the increased speed of working mechanisation permitted would have reduced the likelihood of accidents. Also, coal faces would be straighter due to machine cutting which would have facilitated improved ventilation and, therefore, less chance of explosion through the build up of gas. Perusal of aggregate statistics would indicate this to be the case, the death rate having declined considerably since the 1870s.[2] Closer scrutiny, however, reveals that Scottish miners faced a higher chance of being killed at the end of the period than they had at the turn of the century. Why was this the case? Firstly, the cutting machines and conveyors themselves posed a threat to colliers. As did the power sources used to drive them. In Scottish pits this was invariably electricity. It is evident that coal cuttermen and their assistants sustained a higher rate of injury than any other group of workers in the pits. Mechanised cutting also meant that a greater area of roof was left unsupported during the cutting operation which resulted in increased injuries from falls of ground. The diffusion of face conveyors increased these risks. However, if proper work systems were followed, which ensured that propping of roofs was carried out in sequence, then the safety of mineworkers could be improved. The safety record of Newbattle Colliery proves this beyond any doubt. Unfortunately, this colliery was the exception not the norm in Scottish mining. Miners were subjected to greater risks below ground and these risks were multiplied due to the additional hazards of noise, vibration and dust that accompanied mechanised production.

The micro-study of the Wemyss Coal Company's Earlseat, Muiredge and Rosie mines provides undeniable evidence that Scottish mieworkers faced a greater risk of injury when working in mechanised pits than they had in mines which still won coal by traditional hand-holing methods. A comparison of data from the Earlseat and Muiredge pits makes this patently obvious. Yet, accident rate statistics were highest at the Rosie mine. This pit had changed to mechanised production in the years shortly after the study began which strongly indicates that the transition period between hand and machine mining was the most dangerous for colliers. Data in tables 4.8 and 4.9 also imply this to be true. So, if Scottish mineworkers were at their greatest risk during the initial period of modernisation why were mortality rates so high in the 1930s? The fact that the diffusion of machinery was an ongoing and accelerating process throughout the period meant Scottish mineworkers were continually faced with these new dangers. Thus, the rolling effect of mechanisation throughout the various coal mining areas and throughout the years of this study continually put Scottish miners at risk and it is this fact which explains why mineworkers in Scotland faced a greater risk of death at the end of this period than they had in the 1890s.

In answer to the charge that mine labour adopted obstructive attitudes to the diffusion of machine cutting and conveying it has been proven that this was not the case with Scottish mineworkers. No evidence has been found of any strike or dispute where Scottish colliers were directly opposed to the introduction of new technology. Contrary to Elbaum and Lazonick's theories there is ample evidence which depicts Scottish miners as having a progressive outlook to technological change. Neither they nor their labour organisations obstructed the diffusion of machinery. The speed of growth of mechanisation in Scotland underpins this fact. Indeed, there is an argument that the weakness of mining unions in Scotland was an important factor which paved the way for mechanisation. The threat of unemployment was greater in Scottish pits in the depression years. Scottish mines shed one third of her labour force while collieries south of the Tweed only one quarter of mine labour experienced unemployment. This undoubtedly had a sobering effect on those miners still in work and, thus could account for their acquiescence. However, while this may explain a lack of opposition and resistance to new work methods it does not explain why Scottish miners, as noted by several different observers, proved so helpful and co-operative as regards the successful introduction of machine cutters and conveyors. Taking this evidence on board it can be argued that labour in Scottish coal mines was not a factor which forced Scottish coal producers to delay or abandon modernisation plans.

Could it be that the cooperation of Scottish mineworkers was achieved by the prospect of financial gain? In other words, did working in mechanised mines mean higher wages for Scottish colliers? This study has failed to produce any significant indication that this was the case. Indeed, the opposite was true for some miners. Evidence has been produced which reveals that some machinemen were earning less than hand-hewers.[3] Thus, it is highly improbable that Scottish miners accepted mechanisation because of the increased remuneration it afforded them.

Was the lack of opposition to new technology by Scottish mining labour down to ignorance? In other words, was the switch to machine mining carried out in such a fashion that miners failed to recognise the significance of the change until it was too late? A Campbell has argued this point and the contention holds water if we are dealing with a relatively short time span. But the argument loses its force when one talks of a period of half a century. The impact of mechanisation on work, safety and labour relations, as the evidence produced in this thesis has shown, was so significant that Scottish miners could not fail to notice it .

Turning to the point that a rift existed between some rank and file miners and their union executive evidence of such a split has been found. However, the difference in outlook between the two was not necessarily caused by the growing move to machine mining. It has been shown that trade union leaders over a long period of time have given their full support to the modernisation of the industry. Similarly, evidence showing Scottish mineworkers as adopting forward-looking and cooperative attitudes to mechanisation is also clear. Although some sections of the rank and file took independent strike action over tonnage or filling rates this does not mean these miners were anti-modernisation. It merely shows they disagreed with the proposed level of remuneration for certain tasks under the new working system.

The in-depth case studies of Lanarkshire and Ayrshire have shown that many varied and disparate issues lay behind industrial unrest in each area and in both time periods. However, one thing seems clear. A link exists between high levels of labour unrest and mechanisation. It has been proven statistically that the incidence of industrial unrest was much higher in mechanised mines than it was in pits that still relied on traditional hand-hewing methods. Why? Changes to work systems below ground, which were a necessary corollary of modern mining practice, were pivotal in ensuring the potential for labour unrest was ever present in Scottish pits. For one thing, the greater presence of supervisory staff in the pits meant a decline in face to face contact between owners/management and rank and file workers. This detracted from the chance of a quick resolution of problems and helped formalise industrial relations in Scottish pits as miners went through their union representatives to redress their grievances. Furthermore, the growing move to mechanised longwall mining meant Scottish colliers were grouped in larger work squads with closer and stricter supervision. This encouraged the spread of shared grievances, another ingredient which ensured friction was always close at hand. However, the evidence overwhelmingly indicates that the pressures brought by these new work systems created a major source of potential unrest. The combination of more arduous and dangerous work, wrought over longer hours, being paced by machinery and subjected to greater and more intensive supervision ensured that strife, hostility and argument were ever present in Scottish pits. All these factors helped produce a 'latent culture of anger' in Scottish pits that ensured that volatile labour relations remained a feature of the heavily mechanised Scottish mining industry. The findings of this study suggest that Church's argument that mechanisation was not central to changes in work organisation or industrial relations between the wars needs to be reconsidered. Indeed, the changes in work organisation and the pressures brought by technological change were a major factor in creating the potential for dispute in Scottish pits. Whether this was then translated into conflict depended upon other factors. However, the evidence of this thesis suggests that the impact of mechanisation on industrial relations in Scotland's coalmines requires to be re-evaluated and does not deserve to be relegated to the sidelines.

It is hoped that this study of Scottish mining between the years 1890-1939 has gone some way to filling a gap in the existing historiography. Firstly, as a fresh, updated look at Scottish mineworkers in the early part of this century. More importantly, however, it is hoped that this study of one group of British industrial workers will help elucidate the intricate and far reaching consequences encountered when new technology is introduced into the work place. In particular the interaction of the impact technological change on the work, health and safety of workers and the implications this has on labour relations.

Notes for Chapter 6.

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[1]See chapter one, pp 21-22.
[2]See tables 6.1 and 6.2, takes 4.1 and 4.2 pp 153-154
[3]See chapter 5, pp 205-206.

APPENDIX

TABLE 2.1.7 EMPLOYMENT AND OUTPUT AYRSHIRE 1890-1914.

Year	Employees (000s)	% Scotland	Output (000 tons)	% Scotland
1890	11.60	14.30	3159.70	13.00
1891	12.20	14.10	3386.00	13.30
1892	12.60	13.90	3579.20	13.20
1893	12.90	14.20	3325.90	13.10
1894	13.20	14.10	2590.40	12.10
1895	13.00	13.80	3667.20	12.70
1896	12.50	14.10	3565.70	12.60
1897	12.60	14.20	3585.40	12.30
1898	12.60	13.70	3753.70	12.40
1899	12.80	13.30	3809.30	12.20
1900	13.40	12.90	4042.50	12.20
1901	13.50	12.50	4046.30	12.30
1902	13.10	12.00	4044.90	11.90
1903	12.70	11.40	4025.60	11.50
1904	12.90	11.40	4079.80	11.50
1905	12.60	11.00	4139.80	11.50
1906	12.80	11.10	4310.30	11.40
1907	13.00	10.40	4073.30	10.20
1908	13.80	10.40	4058.10	10.40
1909	13.80	10.30	4071.70	10.20
1910	13.90	10.10	4018.10	9.70
1911	14.50	10.50	4204.80	10.10
1912	15.10	10.50	3936.00	9.90
1913	15.20	10.30	4193.80	9.90
1914	15.10	10.30	4098.60	10.60

TABLE 2.1.8 EMPLOYMENT AND OUTPUT, CLACKMANNAN,

1890	1.30	1.60	402.70	1.70
1891	1.40	1.60	444.20	1.70
1892	1.40	1.50	412.50	1.50
1893	1.40	1.50	410.40	1.60
1894	1.40	1.50	297.60	1.40
1895	1.30	1.40	404.50	1.40
1896	1.00	1.10	329.60	1.20
1897	1.00	1.10	341.80	1.20
1898	1.00	1.10	345.60	1.10
1899	1.00	1.00	366.70	1.20
1900	1.00	1.00	424.70	1.30
1901	1.20	1.10	429.80	1.30
1902	1.20	1.10	426.80	1.30
1903	1.20	1.10	405.40	1.20
1904	1.20	1.10	420.50	1.20
1905	1.20	1.00	384.20	1.10
1906	1.20	1.00	385.50	1.00
1907	1.30	1.00	420.00	1.00
1908	1.30	1.00	406.50	1.00
1909	1.40	1.00	408.80	1.00
1910	1.40	1.00	405.90	1.00
1911	1.30	1.00	414.70	1.00
1912	1.30	0.90	343.10	0.90
1913	1.30	0.90	342.50	0.80
1914	1.20	0.80	296.80	0.80

Source: Annual Reports of the Chief Inspector of Mines, 1890-1914

TABLE 2.1.9 EMPLOYMENT AND OUTPUT, DUMBARTON, 1890-1914.

Year	Employees (000s)	% Scotland	Output (000sTons)	% Scotland
1890	1.90	2.30	339.60	1.40
1891	1.90	2.20	366.20	1.40
1892	2.20	2.40	434.80	1.60
1893	2.40	2.60	437.50	1.70
1894	2.40	2.60	400.30	1.90
1895	2.40	2.60	544.50	1.90
1896	2.30	2.60	494.80	1.70
1897	2.20	2.50	500.00	1.70
1898	2.20	2.40	521.30	1.70
1899	2.10	2.20	511.20	1.60
1900	2.20	2.10	535.00	1.60
1901	2.30	2.00	501.20	1.50
1902	2.30	2.10	503.20	1.50
1903	2.20	2.00	503.90	1.40
1904	1.90	1.70	495.30	1.40
1905	1.90	1.70	452.90	1.30
1906	2.10	1.80	467.00	1.20
1907	1.90	1.50	493.50	1.20
1908	2.00	1.50	497.00	1.30
1909	2.00	1.50	477.80	1.20
1910	2.20	1.60	558.40	1.40
1911	2.20	1.60	559.10	1.30
1912	2.30	1.60	483.80	1.20
1913	2.40	1.60	518.00	1.20
1914	2.60	1.80	471.60	1.30

TABLE 2.1.10 EMPLOYMENT AND OUTPUT STIRLING,

1890	5.40	6.70	1498.10	6.20
1891	5.80	6.70	1606.30	6.30
1892	6.30	7.00	1745.20	6.40
1893	6.70	7.40	1635.60	6.40
1894	6.80	7.20	1421.90	6.60
1895	6.90	7.30	1903.30	6.60
1896	6.40	7.20	1986.10	7.00
1897	6.60	7.40	2143.20	7.40
1898	7.10	7.70	2260.20	7.50
1899	7.20	7.50	2270.00	7.30
1900	7.70	7.40	2323.00	7.00
1901	7.70	7.10	2306.90	7.00
1902	7.80	7.20	2342.20	6.90
1903	7.70	6.90	2298.70	6.60
1904	8.00	7.10	2305.20	6.50
1905	8.30	7.00	2384.70	6.70
1906	9.00	7.80	2701.20	7.10
1907	9.90	7.90	2965.10	7.40
1908	10.40	7.90	2954.30	7.50
1909	10.20	7.60	2917.30	7.30
1910	10.60	7.70	3075.80	7.40
1911	10.50	7.60	3112.90	7.50
1912	10.60	7.40	2831.10	7.20
1913	10.70	7.30	3038.90	7.20
1914	10.50	7.20	2669.40	6.90

Source: Annual Reports of the Chief Inspector of Mines, 1890-1914.

TABLE 2.1.11 EMPLOYMENT AND OUTPUT EDINBURGH, 1890-1914.

Year	Employees (000s)	% Scotland	Output (000sTons)	% Scotland
1890	5.80	7.20	868.90	3.60
1891	6.60	7.60	883.90	3.50
1892	6.40	7.10	928.70	3.40
1893	6.00	6.60	872.60	3.40
1894	6.20	6.60	720.70	3.40
1895	6.10	6.50	1076.70	3.80
1896	6.00	6.80	1096.90	3.90
1897	5.80	6.50	1144.50	3.90
1898	5.80	6.30	1244.70	4.10
1899	5.80	6.00	1267.50	4.10
1900	6.40	6.20	1329.50	4.00
1901	6.50	6.00	1364.40	4.20
1902	6.80	6.20	1438.80	4.20
1903	7.20	6.50	1623.40	4.60
1904	7.80	6.90	1775.50	5.00
1905	8.10	7.10	1914.00	5.30
1906	8.60	7.40	2147.20	5.70
1907	9.00	7.20	2344.80	5.80
1908	9.50	7.20	2349.40	6.00
1909	9.90	7.40	2634.40	6.60
1910	10.50	7.60	2991.80	7.20
1911	10.80	7.80	3038.90	7.30
1912	11.00	7.70	3064.90	7.80
1913	11.70	7.90	3203.70	7.50
1914	11.90	8.10	3093.30	8.00

TABLE 2.1.12 EMPLOYMENT AND OUTPUT, HADDINGTON.

1890	1.00	1.20	300.20	1.20
1891	1.10	1.30	278.80	1.10
1892	1.10	1.30	297.00	1.10
1893	1.10	1.20	333.10	1.30
1894	1.10	1.20	248.30	1.60
1895	1.10	1.20	325.60	1.10
1896	1.00	1.10	352.90	1.20
1897	1.00	1.10	380.70	1.30
1898	1.10	1.20	410.70	1.40
1899	1.10	1.10	450.60	1.40
1900	1.20	1.20	464.80	1.40
1901	1.30	1.20	467.20	1.40
1902	1.60	1.50	505.80	1.50
1903	1.70	1.50	567.30	1.60
1904	1.80	1.60	637.90	1.80
1905	2.10	1.80	770.30	2.10
1906	2.40	2.10	929.90	2.40
1907	2.90	2.30	1069.70	2.70
1908	3.20	2.40	1076.30	2.70
1909	3.20	2.40	1048.50	2.60
1910	3.30	2.40	1088.40	2.60
1911	3.00	2.20	1021.20	2.40
1912	3.30	2.30	1050.70	2.70
1913	3.60	2.40	1117.00	2.60
1914	3.40	2.30	1105.10	2.80

Source: Annual Reports of the Chief Inspector of Mines, 1890-1914.

TABLE 2.1.13 EMPLOYMENT AND OUTPUT FIFE, 1890-1914.

YEAR	EMPLOYEES (000s)	%SCOTLAND	OUTPUT (000sTons)	%SCOTLAND
1890	9.60	11.80	3121.60	12.90
1891	10.90	12.60	3301.00	13.00
1892	11.80	13.00	3573.80	13.10
1893	11.90	13.10	3619.50	14.20
1894	12.30	13.10	2784.00	13.00
1895	12.50	13.30	3911.20	13.60
1896	11.60	13.10	3633.50	12.80
1897	11.90	13.40	4077.90	14.00
1898	12.90	14.00	4447.60	14.70
1899	13.80	14.40	4927.50	15.80
1900	15.10	14.50	5419.40	16.40
1901	16.20	15.00	5601.50	17.10
1902	16.90	15.50	6134.20	18.00
1903	17.80	16.00	6377.00	18.20
1904	18.40	16.30	6586.20	18.60
1905	19.60	17.10	7241.40	20.20
1906	20.60	17.80	7783.50	20.50
1907	23.40	18.80	8530.00	21.30
1908	25.40	19.20	8412.90	21.50
1909	26.20	19.60	8425.80	21.20
1910	27.40	19.90	8674.40	21.00
1911	27.40	19.80	9037.80	21.70
1912	28.70	20.00	8435.60	21.30
1913	29.30	19.90	9680.20	22.80
1914	29.20	20.00	8259.60	21.30

TABLE 2.1.14 EMPLOYMENT AND OUTUT, LANARK.

1890	37.30	46.00	13584.80	56.00
1891	39.40	45.50	14093.40	55.50
1892	42.10	46.50	15253.00	56.10
1893	42.10	46.40	13296.40	54.70
1894	44.20	47.10	12216.20	58.90
1895	43.90	46.70	15922.80	55.30
1896	41.50	46.70	15805.20	55.80
1897	41.80	47.00	15822.30	54.40
1898	43.10	46.80	16142.60	53.40
1899	45.60	47.50	16416.80	52.70
1900	48.90	47.10	17174.30	51.90
1901	51.40	47.60	16603.20	50.60
1902	51.20	47.00	17049.30	50.00
1903	52.30	47.10	17350.40	49.60
1904	51.90	46.00	17183.80	48.50
1905	51.50	45.20	16755.60	46.80
1906	50.20	43.40	17215.40	45.30
1907	53.50	42.90	17968.20	44.80
1908	55.30	41.90	17026.40	43.50
1909	55.20	41.30	17299.00	43.50
1910	56.20	40.80	17886.10	43.30
1911	55.70	40.20	17504.90	42.00
1912	57.90	40.40	16624.40	42.10
1913	60.10	40.70	17486.30	41.20
1914	59.40	40.60	16247.40	41.80

Source: Annual Reports of the Chief Inspector of Mines, 1890-1914.

TABLE 2.1.15 EMPLOYMENT AND OUTPUT LINLITHGOW, 1890-1914.

Year	Employees (000s)	% Scotland	Output (000sTons)	% Scotland
1890	5.40	6.70	782.70	3.20
1891	5.70	6.60	856.50	3.40
1892	5.20	5.70	778.60	2.90
1893	4.90	5.40	731.40	2.90
1894	4.90	5.20	630.70	2.90
1895	5.40	5.70	866.50	3.00
1896	5.00	5.60	882.90	3.10
1897	5.10	5.70	896.90	3.10
1898	4.90	5.30	910.30	3.00
1899	5.30	5.50	948.70	3.00
1900	6.30	6.10	1184.10	3.60
1901	6.80	6.30	1316.10	4.00
1902	6.70	6.10	1434.70	4.20
1903	6.80	6.10	1537.10	4.40
1904	7.20	6.40	1581.70	4.50
1905	7.20	6.30	1467.20	4.10
1906	7.40	6.40	1683.60	4.40
1907	8.10	6.50	1805.30	4.50
1908	9.00	6.80	1865.20	4.80
1909	9.40	7.00	1988.00	5.00
1910	9.80	7.10	2059.40	5.00
1911	10.30	7.40	2178.80	5.20
1912	10.20	7.10	2038.10	5.20
1913	10.20	6.90	2057.30	4.80
1914	10.00	6.80	1870.90	4.80

TABLE 2.1.16 EMPLOYMENT AND OUTPUT SCOTLAND.(as % of U K)

1890	81.10	12.80	24278.60	13.40
1891	86.60	13.00	25383.10	13.70
1892	90.60	13.20	27192.00	15.00
1893	90.80	13.30	25482.60	15.50
1894	93.80	13.30	21481.60	11.40
1895	94.00	13.40	28792.60	15.20
1896	88.80	12.80	28326.50	14.50
1897	89.00	12.60	29082.30	14.40
1898	92.10	13.00	30297.30	15.00
1899	95.90	13.20	31142.60	14.20
1900	103.80	13.30	33112.10	14.70
1901	108.00	13.40	32796.60	15.00
1902	109.00	13.20	34115.40	15.00
1903	111.10	13.20	34992.00	15.20
1904	112.80	13.30	35453.00	15.30
1905	114.30	13.30	35839.30	15.20
1906	115.70	13.10	37992.40	15.10
1907	124.80	13.30	40092.60	15.00
1908	132.10	13.40	39158.20	15.00
1909	133.60	13.20	39768.30	15.10
1910	137.90	13.10	41335.10	15.60
1911	138.40	13.00	41718.20	15.30
1912	143.30	13.20	39518.60	15.20
1913	147.40	13.10	42456.50	14.80
1914	146.20	12.90	38847.40	14.60

Source: Annual Reports of the Chief Inspector of Mines, 1890-1914.

TABLE 2.1.17 EMPLOYMENT AND OUTPUT GREAT BRITAIN, 1890-1914.

YEAR	EMPLOYEES	OUTPUT
1890	632.80	181.60
1891	668.00	185.50
1892	683.60	181.70
1893	683.00	164.30
1894	705.20	188.30
1895	700.30	189.70
1896	692.70	195.40
1897	704.50	202.00
1898	706.90	202.00
1899	729.00	220.10
1900	780.10	225.20
1901	806.70	219.00
1902	824.80	227.10
1903	842.10	230.30
1904	847.60	232.40
1905	858.40	236.10
1906	882.30	251.10
1907	940.60	267.80
1908	987.80	261.50
1909	1014.00	263.80
1910	1049.40	264.40
1911	1067.20	271.90
1912	1089.10	260.40
1913	1127.90	287.40
1914	1133.70	265.60

Source: Annual Reports of the Chief Inspector of Mines, 1890-1914.

TABLE 2.1.18 OMY SCOTLAND & Gt.BRITAIN, 1890-1914

Year	Ayrshire	Clackmn.	Dumbarton	Edinburgh
1890	272	310	179	150
1891	278	317	193	134
1892	284	295	198	145
1893	258	293	182	145
1894	196	213	167	116
1895	282	311	227	177
1896	285	330	215	183
1897	286	342	227	197
1898	298	346	237	215
1899	298	367	243	219
1900	302	425	243	208
1901	300	358	228	210
1902	309	356	219	232
1903	317	338	229	225
1904	316	350	261	228
1905	329	320	238	236
1906	337	321	222	250
1907	313	323	240	261
1908	294	313	249	247
1909	295	292	239	266
1910	289	290	254	285
1911	290	319	254	281
1912	261	264	210	279
1913	276	263	216	274
1914	271	247	181	260

Year	Fife	Haddington	Lanark	Linlithgow
1890	325	300	364	145
1891	303	253	357	150
1892	303	270	362	150
1893	304	303	331	149
1894	226	226	276	129
1895	313	296	363	160
1896	313	353	381	177
1897	343	381	379	176
1898	345	373	375	186
1899	357	410	360	179
1900	359	387	351	182
1901	346	359	323	194
1902	363	316	333	214
1903	358	334	332	226
1904	358	354	381	220
1905	369	367	328	204
1906	379	387	343	228
1907	365	369	336	223
1908	331	336	308	207
1909	322	328	313	211
1910	317	330	318	210
1911	330	340	314	212
1912	294	318	287	200
1913	330	310	291	202
1914	283	325	276	187

TABLE 2.1.18 continued.

Year	Stirling	Scotland	Gt. Britain
1890	277	299	287
1891	277	293	277
1892	277	300	266
1893	244	281	241
1894	209	229	267
1895	276	306	271
1896	310	319	282
1897	325	327	287
1898	318	328	286
1899	315	325	302
1900	302	319	289
1901	300	304	271
1902	300	313	275
1903	299	315	273
1904	288	314	274
1905	287	314	275
1906	300	328	286
1907	300	321	285
1908	284	296	265
1909	286	298	260
1910	290	300	252
1911	296	301	255
1912	267	276	239
1913	284	288	255
1914	254	266	234

Source: Annual Reports of the Chief Inspector of Mines, 1890-1914.

TABLE 2.1.19 LEVEL OF MECHANISATION BY DISTRICT.

1904

District	A	B	C	D	E
E, Scotland	34	75	30	45	730,669
W, Scotland	33	95	29	66	968,478
Newcastle	18	47	11	36	401,688
Durham	23	73	42	31	508,392
Yorks & Lincn	48	165	64	101	1,949,119
Manch. & Ireld	16	46	11	35	219,496
L/pool & NWales	18	91	6	85	58,1270
Midland	39	129	65	64	1,118,874
Stafford	12	22	11	11	218,524
Cardiff	5	9	0	9	40,986
Swansea	0	0	0	0	0
Southern	3	3	1	2	6,553
Total	249	755	270	485	5,744,044

1913

District	A	B	C	D	E
Scotland	228	876	700	176	9,335,452
S.Wales	41	115	36	79	63,979
Northern	89	665	134	531	3,545,249
York/N.Midland	164	673	331	342	7,608,530
Manch. & Ireld	40	212	13	199	644,989
L/pool & NWales	66	181	23	158	1,522,962
Midl & Southern	48	175	70	105	1,313,057
Total	676	2897	1307	1590	24,609,958

A= Number of mines using machinery.
B= Number of machines.
C= Number of electrically powered machines.
D= Number of machines driven by compressed air.
E= Tonnage cut by machine.

Source: *Colliery Guardian*, Vol XC, 1905, p 546, and Vol CIX, 1915, p 231.

TABLE 2.3.5 LEVEL OF MECHANISATION, 1921-1938

Fife, Clackmannan, Kinross and Sutherland District.

Year	% Mines using coal cutters	No. Electric cutters	No. Comp/air cutters	% cut by machine
1921	74	251	31	39*
1922	72	252	36	44
1923	79	292	38	47
1924	77	311	32	48
1925	83	314	29	48
1926	82	275	30	53
1927	75	294	25	60
1928	81	314	27	65
1929	80	317	35	71
1930	86	326	22	71
1931	84	316	17	70
1932	84	280	13	75
1933	79	269	9	81
1934	85	299	5	83
1935	81	325	-	86
1936	90	331	-	88
1937	81	334	-	89
1938	86	343	-	90

	No. Face Conveyors	Conveyors Elsewhere	No. Gate-end Loaders	% Conveyed
1921	25	-	-	-
1922	25	-	-	-
1923	54	-	-	-
1924	63	-	-	-
1925	85	-	-	-
1926	113	-	-	-
1927	177	-	-	-
1928	181	71	-	45
1929	191	56	-	54
1930	193	52	24	56
1931	193	53	22	61
1932	177	51	25	66
1933	188	58	19	71
1934	216	80	16	76
1935	248	90	13	80
1936	262	106	14	84
1937	264	110	13	84
1938	272	107	17	84

* Total district output figure used in calculating the % of coal cut by machine for 1921 excludes any output from Kinross and Sutherland. As this output was exiguous its effect on the % noted above is marginal.

Source: Annual Reports of the Secretary of Mines, 1921-38.

TABLE 2.3.6 LEVEL OF MECHANISATION, 1921-1938

Mid and East Lothian and Peebles District

Year	% Mines using coal cutters	No. Electric cutters	No. Comp/air cutters	% cut by machine
1921	45	60	20	21*
1922	51	71	17	25*
1923	51	85	16	31*
1924	54	99	16	35
1925	54	120	10	41
1926	51	109	10	43
1927	64	121	12	44
1928	65	106	10	42
1929	61	122	11	45
1930	58	130	11	47
1931	55	124	9	48
1932	61	128	8	52
1933	61	130	7	54
1934	59	138	5	57
1935	72	144	4	59
1936	72	149	4	60
1937	71	147	6	60
1938	76	168	4	62

	No. Face Conveyors	Conveyors Elsewhere	No. Gate-end Loaders	% Conveyed
1921	25	-	-	-
1922	30	-	-	-
1923	31	-	-	-
1924	38	-	-	-
1925	41	-	-	-
1926	43	-	-	-
1927	44	-	-	-
1928	42	-	-	-
1929	45	9	-	41
1930	47	16	72	45
1931	48	18	72	45
1932	52	20	70	51
1933	54	20	66	50
1934	57	26	75	51
1935	59	24	63	55
1936	60	32	67	56
1937	60	30	67	58
1938	62	38	56	65

* The total district output figure used in calculating the % of coal cut by machine for 1921-1923 excludes any output from the Peebles area. As this output was exiguous its effect on the % noted above is marginal.

Source: Annual Reports of the Secretary of Mines, 1921-38.

TABLE 2.3.7 LEVEL OF MECHANISATION, 1921-1938

Lanark, West Lothian, Stirling, Dumbarton and Renfrew District

Year	% Mines using coal cutters	No. Electric cutters	No. Comp/air cutters	% cut by machine
1921	51	833	56	45*
1922	53	858	48	47*
1923	56	960	46	52*
1924	56	994	55	54
1925	56	963	49	57
1926	49	928	40	59
1927	51	983	39	61
1928	58	942	42	65
1929	54	945	38	69
1930	56	952	27	74
1931	52	854	26	75
1932	48	732	19	75
1933	48	746	14	77
1934	47	751	14	79
1935	47	765	11	81
1936	45	783	16	83
1937	48	800	15	83
1938	46	781	15	84

	No. Face Conveyors	Conveyors Elsewhere	No. Gate-end Loaders	% Conveyed
1921	37	-	-	-
1922	45	-	-	-
1923	36	-	-	-
1924	47	-	-	-
1925	73	-	-	-
1926	98	-	-	-
1927	146	-	-	-
1928	182	77	-	16
1929	176	48	-	19
1930	207	51	74	23
1931	221	53	74	28
1932	224	59	73	32
1933	255	61	76	35
1934	259	61	80	37
1935	289	65	90	40
1936	332	83	87	43
1937	333	93	86	45
1938	352	94	87	46

* The total district output figure used in calculating the % cut by machine for 1921-1923 excludes any output from the Renfrew area. As this output was exiguous its effect on the % noted above is marginal.

Source: Annual Reports of the Secretary of Mines, 1921-38.

TABLE 2.3.8 LEVEL OF MECHANISATION, 1921-1938

Ayrshire, Dumfries and Argyll District

Year	% Mines using coal cutters	No. Electric cutters	No. Comp/air cutters	% cut by machine
1921	21	58	7	16*
1922	23	79	4	22*
1923	26	82	9	27*
1924	31	114	4	26
1925	37	133	6	31
1926	38	134	3	36
1927	40	141	4	36
1928	47	161	2	42
1929	48	169	2	47
1930	48	174	4	51
1931	43	175	1	52
1932	47	184	1	59
1933	52	185	-	59
1934	58	215	-	62
1935	57	238	-	63
1936	58	234	-	69
1937	68	237	-	69
1938	64	230	-	69

Year	No. Face Conveyors	Conveyors Elsewhere	No. Gate-end Loaders	% Conveyed
1921	4	-	-	-
1922	2	-	-	-
1923	2	-	-	-
1924	3	-	-	-
1925	3	-	-	-
1926	7	-	-	-
1927	13	-	-	-
1928	15	3	-	6
1929	21	5	-	6
1930	32	12	6	13
1931	37	17	4	17
1932	43	22	6	22
1933	49	25	5	25
1934	62	30	5	27
1935	81	36	9	32
1936	93	33	8	38
1937	98	46	8	39
1938	97	41	10	39

* The total district output figure used in calculating the % of coal cut by machine for 1921-1923 excludes any output from the Dumfries and Argyll areas. As this output was exiguous its effect on the % noted above is marginal.

Source: Annual Reports of the Secretary of Mines, 1921-38.

TABLE 2.3.9 LEVEL OF MECHANISATION, 1921-1938

Scotland

Year	% Mines using coal cutters	No. Electric cutters	No. Comp/air cutters	% cut by machine
1919	48	1053	136	32
1920	49	1149	131	34
1921	48	1202	114	36
1922	50	1260	105	40
1923	53	1419	109	45
1924	54	1518	110	47
1925	53	1530	94	50
1926	51	1446	83	53
1927	53	1539	80	56
1928	60	1523	81	59
1929	57	1553	86	63
1930	59	1582	64	66
1931	55	1469	53	66
1932	53	1324	41	69
1933	54	1330	30	72
1934	55	1403	24	75
1935	55	1472	15	77
1936	55	1497	20	79
1937	57	1528	21	79
1938	56	1522	19	80

	No. Face Conveyors	Conveyors Elsewhere	No. Gate-end Loaders	% Conveyed
1919	105	-	-	-
1920	109	-	-	-
1921	91	-	-	-
1922	102	-	-	-
1923	123	-	-	-
1924	151	-	-	-
1925	201	-	-	-
1926	269	-	-	-
1927	414	-	-	-
1928	463	193	-	25
1929	475	118	-	29
1930	522	131	176	31
1931	536	141	172	37
1932	535	152	174	42
1933	587	164	166	45
1934	646	197	176	48
1935	733	219	175	52
1936	800	254	176	55
1937	815	279	174	57
1938	849	280	170	58

Source: Annual Reports of His Majesty's Chief Inspector of Mines, 1919-1920, Annual Reports of the Secretary of Mines, 1921-38.

TABLE 2.3.10 LEVEL OF MECHANISATION, 1921-1938

Great Britain

Year	% Mines using coal cutters	No. Electric cutters	No. Comp/air cutters	% cut by machine
1919	26	1950	2532	12
1920	27	2153	2918	13
1921	26	2257	3002	14
1922	27	2395	3039	15
1923	30	2745	3414	17
1924	32	3044	3783	19
1925	34	3133	3514	20
1926	32	3114	3398	22
1927	33	3478	3638	23
1928	36	3586	3545	26
1929	36	3787	3574	28
1930	37	4040	3597	31
1931	38	4026	2245	35
1932	37	3970	3167	38
1933	38	4211	2938	42
1934	40	4451	2955	47
1935	41	4635	2837	51
1936	42	4794	2803	55
1937	43	4997	2784	57
1938	44	5106	2623	59

	No. Face Conveyors	Conveyors Elsewhere	No. Gate-end Loaders	% Conveyed
1919	*	-	-	-
1920	823	-	-	-
1921	818	-	-	-
1922	928	-	-	-
1923	1157	-	-	-
1924	1373	-	-	-
1925	1513	-	-	-
1926	1667	-	-	-
1927	2185	-	-	-
1928	2203	653	-	12
1929	2598	620	-	14
1930	2991	756	453	17
1931	3137	816	506	21
1932	3265	855	526	25
1933	3717	1039	564	30
1934	4090	1279	637	37
1935	4613	1527	692	43
1936	4966	1761	716	48
1937	5287	2013	731	51
1938	5623	2203	766	54

* Data used for 1919-1921 based on figures for the United Kingdom, that is, including Ireland
Source: Annual Reports of His Majesty's Chief Inspector of Mines, 1919-1920, Annual Reports of the Secretary of Mines, 1921-38.

BIBLIOGRAPHY

PRIMARY SOURCES.

Glasgow University Archives [Business Records' Archives], [henceforth GUA], William Baird and Company Ltd., Agenda Books, 1893-1920, UGD/164/1/1/1.

GUA, William Baird and Company Ltd., Valuation Books, 1870-1914. UGD/164/2/5/1-7.

GUA, William Baird and Company Ltd., Notes on Capital Expenditure, UGD/164/1/2/9.

GUA, Bairds and Dalmellington Ltd., Colliery Purchases Ledgers, UGD/3/3/1.

GUA, Board of Conciliation Minutes, 1906-1912, UGD/160/1/1/2.

GUA, Board of Conciliation Minutes, 1913-1921, UGD/160/1/1/3.

GUA, William Dixon Ltd., Cash Books, 1890-1916, UGD/1/16/3-8.

GUA, William Dixon Ltd., Accident Report Book, 1906-1907, UGD/1/34/2.

GUA, William Dixon Ltd., Accident Report Book, 1907-1908, UGD/1/34/1.

GUA, William Dixon Ltd., Letter Book, 1873-1906, UGD/1/55/13.

GUA, The Lanarkshire Coal Masters' Association, Annual Reports and Balance Sheets, 1890-1939, UGD/159/2/1.

GUA, The Lanarkshire Coal Masters' Association, Minutes of Executive Committee, 1890-1939, UGD/159/1/2-UGD/159/1/19.

Mitchell Library Glasgow, [henceforth MLG],

Lanarkshire Miners' County Union, Council Minutes, 1920, 1922, 1925, 1928 & 1929, TU 331.88122 Lan.

MLG, Lanarkshire Miners' County Union, Minutes of Executive Committee, 1924, 1927-1929, TU 331.88122 Lan.

MLG, Miners' Federation of Great Britain, Annual Proceeding and Committee Minutes, 1894-1943, TU 331.88122330942(Min).

National Library of Scotland, [henceforth NLS], Ayrshire Miners' Union, Minute Book, 1926-1930, DEP 258.1.

NLS, Ayrshire Miners' Union, Minute Book, 1931-1935, DEP 258.2.

NLS, Ayrshire Miners' Union, Minute Book, 1936-1940, DEP 258.3.

NLS, Fife and Kinross Miners' Association, Board Minutes, 1894-1900, PDL 44/14.

NLS, Fife and Kinross Miners' Association, Board Minutes, 1900-1913, DEP. 304.1,2,3.

NLS, Lanarkshire Miners' County Union, Minutes of Executive Committee, 1903-1944, DEP 227.48-77.

NLS, Mid and East Lothian Miners' Association, Minute Book, 1894-1901, ACC 4312.6.

NLS, Mid and East Lothian Miners' Association, Minute Book, 1910-1913, ACC 4312.7.

NLS, Mid and East Lothian Miners' Association, Minute Book, 1914-1918, ACC 4312.8.

NLS, National Union of Scottish Mine Workers, Reports on Annual Conferences and Minutes of Executive Committee, 1918-1925, 1928-1939, PDL/45/7.

NLS, National Union of Scottish Mine Workers, Reports on Annual Conferences and Minutes of Executive Committee, 1915-1940, DEP.227.84-93.

NLS, Scottish Miners' Federation, Minute Book, 1894-1900, ACC 4312.19.

NLS, Scottish Miners' Federation, Minute Book, 1900-1905, ACC 4312.20.

NLS, Scottish Miners' Federation, Minute Book, 1905-1907, ACC 4312.21.

NLS, Amalgamated Miners and Manual Workers, West Lothian, Minute Book, 1899-1913, ACC 4312.1.

Scottish Records Office, [henceforth SRO], Fife Coal Company Ltd., Investment Ledger, 1906-1952, CB.3/79.

SRO, Fife Coal Company Ltd., Private Ledgers, 1889-1914, CB.3/93,94 & 95.

SRO, Fife Coal Company Ltd., General Ledgers, 1887-1910, CB.3/109-117.

SRO, The Lanarkshire Coal Masters' Association, Annual Reports, 1887-1906, CB.8/2.

SRO, The Lanarkshire Coal Masters' Association, Annual Reports, 1909-46, CB.8/3.

SRO, Lochgelly Iron and Coal Company, Minute Books, 1891-1906, CB.2/203 & 204.

SRO, Lochgelly Iron and Coal Company, Agenda Books, 1886-1918, CB.2/194-201.

SRO, Wemyss Coal Company Ltd., Accident Books, 1906-1926, CB1/RH4/142/449-451.

Strathclyde Regional Archives, Notes on Coal Mining in Lanarkshire, TD729/1,2 & 4.

Strathclyde University Archives, [henceforth SUA] Scottish Iron and Steel Company Ltd., (Wm. Baird & Co.,) Inventory Book, Gartsherrie, 1925-1933. (Uncatalogued Collection).

SUA, Scottish Iron and Steel Company Ltd., Managers Note Book, Gartsherrie, 1844-.

SUA, Proceeding of the Philosophical Society of Glasgow, Vol XXIV, 1892-1893.

GOVERNMENT PUBLICATIONS AND PARLIAMENTARY PAPERS.

Annual Reports of His Majesty's Chief Inspector of Mines, 1890-1939.

Annual Reports of the Secretary for Mines, 1921-1938.

List of Mines, 1890-1892, 1895, 1896, 1904-1906, 1910, 1914, 1915, 1917, 1919, 1920, 1932-1936, 1938.

Ministry of Labour Gazette, 1922-1939.

Final Report of the Royal Commission on Coal Supplies, (B P P) 1905, (Cd.2359). Part VIII, Report of J S Dixon on Available Coal Resources of District F, (Scotland).

Report of the Miner's Eight Hour Day Committee, (B P P), 1907, Part III,(Cd 3428).

Final Report of the Departmental Committee on the Probable Economic Effects of a Limit of Eight Hours to the Working Day of Coal Miners, (B P P), 1907, Part I & II, (Cd 3505,3506)

Report on Strikes and Lock-outs and on Conciliation and Arbitration Boards, (B P P) 1913, (Cd 7658).

Report of the Coal Industry Commission, (B P P) 1919, (Sankey), Vol III, (Cmd.361).

Report of the Royal Commission on the Coal Industry, (B P P) 1925, (Cmd.2600).

Report of the Special Inquiry into the Working of Overtimne in Coal Mines in Scotland, (B P P) 1934-5, (Cmd.4959).

Report on the British Coal Industry, P.E.P.(Political and Economic Planning) 1936.

Royal Commission on Safety in Coal Mines, Minutes of Evidence, 1936, Parts I,II, and III.

Royal Commission on Safety in Coal Mines, (B P P) 1938-9, (Cmd.5890).

Report of the Technical Advisory Committee on Coal Mining, (B P P), 1944/45, (Cmd. 6610).

NEWSPAPERS AND TRADE JOURNALS.

Airdrie and Coatbridge Advertiser.

Colliery Guardian, 1890-1939.

Daily Record.

The Times.

Glasgow Herald.

Forward.

Motherwell Times.

CONTEMPORARY PRINTED TEXTS

Unless otherwise stated place of publication is London

Barratt Brown A, *The Machine and the Worker*, (Nichol & Watson, 1934).

Bulman H F, *Coal Mining and the Coal Miner*, (1920).

Coombes B L, *I Am a Miner*, (Fact, 1939).

Dron R W, *The Economics of Coal Mining*, (E Arnold & Co.,1928).

Hyslop J, *Colliery Management*, Second edition, (Hutchings, 1876).

Jones J, *The Coal Scuttle*, (Faber & Faber, 1936).

Kerr G L, *Practical Coal Mining*, fifth edition, (C Griffin, 1914).

Knox J, *Airdrie*, (Baird & Hamiliton, Airdrie, 1921).

MacKinnon J, *The Social and Industrial History of Scotland, from the Union to the Present Day*, (Blackie, Glasgow, 1921).

Mining Association of Great Britain, *Historical Review of Coalmining*, 1924.

Percy C M, *The Mechanical Equipment of Collieries,* (Collins, Manchester, 1905).

Raynes J R, *Coal and its Conflicts,* (Ernest Benn Ltd., 1928).

Small R, *The Cry from the Mine* n.d. (c. 1911.)

Stewart W D, *Mines, Machines and Men*, (1935).

Wheatley J, *Miners, Men and Misery,* (Glasgow, n.d.).

Williams M D, *Practical Machine Mining*, (1928).

SECONDARY PRINTED TEXTS.

Aldcroft D H, 'Technical Progress and British Enterprise, 1875-1914', *Business History*, [*BS*], Vol VIII, No. 2, (1966), pp 122-139.

Bain G and Price R, *Profiles of Union Growth*, (Blackwell, Oxford, 1980).

Beachem A, 'Efficiency and Organisation of the British Coal Industry', *The Economic Journal*, Vol LV, (1945), pp 206-216.

Benson I & Lloyd J, *New Technology and Technical Change*, (Kogan Page, 1983).

Benson J, *British Coal Minres in the Nineteenth Century, A Social History*, (Gill & MacMillan, 1989).

Benson J, 'Non-fatal Coalmining Accidents', *Society for the Study of Labour History*, [henceforth *SSLH*], Bulletin No. 32, (Spring 1976), pp 20-22.

Bowley A L, *Wages in the United Kingdom in the Nineteenth Century,* (Cambridge University Press, 1900).

Bulmer M I A, 'Sociological Models of the Mining Community', *The Sociological Review*, Vol 23, (New Series) (1975), pp 61-92.

Burnett J, (ed), *Useful Toil, Autobiographies of Working People from the 1820s to the 1920s*, (Allen Lane, 1994).

Buxton N K, 'Entrepreneurial Efficiency in the British Coal Industry Between the Wars', *Economic History Review*, [henceforth *EHR*], Vol XXIII, (No.1), (1970), pp 476-497.

Buxton N K, 'Entrepreneurial Efficiency in the British Coal Industry Between the Wars: Reconfirmed' *EHR*, Vol XXV, (No. 4), (1972), pp 658-673.

Buxton N K, *The Economic Development of the British Coal Industrial Revolution to the Present day,* (Batsford, 1978).

Campbell A, *The Lanarkshire Miners: A Social History of Their Trade Unions, 1775-1874*, (J Donald, Edinburgh, 1979).

Campbell A, 'Colliery Mechanisation and the Lanarkshire Miners', *SSLH*, Bulletin No. 49, Autumn (1984), pp 37-43.

Campbell A, 'The CP in the Scots coalfields' in Andrews, Fishman and Morgan, (eds), *Opening the Books*,

Campbell A, 'The Social History of Political Conflict in the Scots Coalfields', in Campbell, Fishman and Howell, (eds), *Miners, Unions and Politics, 1910-1947*, (Scolar Press, Aldershot, 1996).

Campbell R H, *The Rise and Fall of Scottish Industry, 1707-1939*, (J Donald, Edinburgh, 1980).

Campbell R H, *Scotland Since 1707 the Rise of an Industrial Society*, Second Edition, (J Donald, Edinburgh, 1985).

Carvel J L, *Fifty Years of Machine Mining Progress, 1899-1949,* (Glasgow, 1949).

Church R, *The History of the British Coal Industry, Vol 3, 1830-1913, Victorian Pre-eminence,* (Clarendon Press, Oxford, 1986).

Church R, Outram Q and Smith D, 'British Coalmining Strikes, 1873-1940: Dimensions, Distribution and Persistence', *British Journal of Industrial Relations,* Vol 28, 3, 1990, pp 329-349.

Church R, 'Employers, Trade Unions and the State', in Feldman G D & Tenfelde K, (eds), *Workers, Owners and Politics in Coalmining: an international comparison,* (Oxford University Press, 1990).

Clegg H A, Fox A & Thompson A F, *A History of British Trade Unions since 1889* Vol 1, 1889-1910, (Clarendon Press, Oxford, 1964).

Coleman D C & MacLeod C, 'Attitudes to new Technology: British Businessmen 1800-1950', *EHR*, Vol XXXIX, (1986), pp 588-611.

Cronin J E, *Industrial Conflict in Modern Britain*, (Croom Helm, 1979).

Cutler T, 'The Romance of Labour', *Economy and Society,* Vol 7, No. 1, (February 1975), pp 74-95.

Dickson T (ed), *Capital and Class in Scotland*, (J Donald, Glasgow, 1982).

Dinenfass M, 'Entrepreneurial Failure Reconsidered: The Case of the Interwar British Coal Industry', *Business History Review*, No 62, (Spring 1988), pp 1-34.

Duncan R, *Shotts Miners Conflicts and Struggles, 1919-1960*. (Motherwell District Libraries, Motherwell, 1985).

Duncan R, *'Steelopolis' The Making of Motherwell c.1750-1939*. (Motherwell District Libraries, Motherwell, 1991).

Duncan R & McIvor A, (eds), *Militant Workers*, (J Donald, Glasgow, 1991).

Elbaum B & Lazonick W, 'The Decline of the British Economy: An Institutional Perspective', *Journal of Economic History*, [henceforth *JEH*], Vol 44, (1984), pp 567-584.

Fine B, *The Coal Question, Political Economy and Industrial Change from the Nineteenth Century to the Present Day*, (Routledge, 1990).

Friedman A L, *Industry and Labour: Class Struggle at Work and Monopoly Capitalism,* (MacMillan, 1977).

Gallacher W, 'Coal Cutting in Lanarkshire Mines, *SSLH*, Bulletin No. 49, (Autumn 1984), pp 43-45.

Galloway R L, *A History of Coal Mining in Great Britain*, (David & Charles, Newton Abbot, 1969).

Gennard J & Dunn S, 'The Impact of New Technology on the Structure and Organisation of Craft Unionsin the Printing Industry', *British Journal of Industrial Relations*, (March 1983), pp 17-32.

Gennard J, *A Histiry of the National Graphical Association,* (Unwin & Hyman, 1990).

Goldthorpe J H, 'Technical Prganisation as a Factor in Supervisor-Worker Conflict', *British Journal of Sociology*, Vol X, No. 3, (1959), pp 213-230.

Gospel H F, *Markets, Firms, and the Management of Labour in Modern Britain*, (Cambridge University Press, 1992).

Greasley D, 'The Diffusion of Machine Cutting in the British Coal Industry 1902-1938', *Explorations in Economic History*, Vol 19, (1982), pp 246-268.

Griffin A R, *Coalmining*, (Longman, 1971).

Griffin A R, *The British Coalmining Industry: Retrospect and Prospect*, (Moorlend, Stoke on Trent, 1977).

Halsey A H, (ed), *British Social Trends since 1900*, (Macmillan, Second edition, 1988).

Harrison R, (ed), *Independent Collier: the Coal Miner as Archetypal Proletarian, Reconsidered*, (Harvester Press, 1978).

Heinemann M, *Britain's Coal, A Study of the Mining Crisis,* (Gollancz, 1944).

Heim C E, 'Structural Transformation and the Demand for Labour in Advanced Economies: Inter-War Britain', *JEH*, Vol 44, (1984), pp 931-952.

Hinton J, *Labour and Socialism, a History of the British Labour Movement, 1867-1974*, second edition, (Wheatsheaf Books, Sussex, 1986).

Kenefick W & McIvor A J, (eds), *The Roots of Red Clydeside, 1910-1914, Labour Unrest and Industrial Relations in West Scotland*, (J Donald, Glasgow, 1996).

Kirby M W, 'The Control of Competition in the British Mining Industry in the Thirties', *EHR*, Vol LXXVI, (2), (1973), pp 273-284.

Kirby M W, *The British Coalmining Industry 1870-1946*, (MacMillan, 1977).

Leneman L, 'Workmen's Compensation at the Wemyss Coal Company, 1906-1924', *Scottish Economic and Social History*, Vol 13, (1993), pp 43-56.

Lenman B, *An Economic History of Modern Scotland 1660-1976*, (Batsford, 1977).

Lewchuk W A, 'The Role of the British Government in the Spread Scientific Management and Fordism in the Inter war Years', *JEH*, Vol 44, (1984), pp 355-362.

May T, *An Economic and Social History of Britain 1760-1970*, (Longman, 1987).

McCloskey D N, *Essays on a Mature Economy: Britain After 1840*, (Meuthen, 1971).

MacDougall I, (ed), *Militant Miners*, (Polygon Books, Edinburgh, 1981).

MacDougall I, *Mungo Mackay and the Green Table, Newtongrange Miners Remember,* (Tuckwell Press, East Linton, East Lothian, 1995).

Marwick A, *Scotland in Modern Times*, (F Cass, 1964).

McKechnie J & McGregor M, *A Short History of the Scottish Coal Mining Industry*, (NCB Scottish Division, Glasgow, 1958).

Melling J & McKinlay A, *Management, Labour and Industrial Politics in Modern Europe: the quest for productivity growth during the twentieth century*, (Brookfield, Cheltemham, 1996).

Monds J, 'Workers Control and the Historians: A New Economism', *New Left Review*, 97, (1976), pp 81-100.

More C, *Skill and the English Working Class 1870-1914*, (Croom Helm, 1980).

Muir A, *The Fife Coal Company Limited: A Short History*, (Cambridge, 1954).

Neville R G & Benson J, 'Labour in the Coalfields (II)', *SSLH,* Bulletin No. 31, (Autumn 1975), pp 45-59.

O'Hare L, *The Stanrigg Pit Disaster*, (Monkland Library Services, Glasgow, 1988).

Page-Arnot R, *A History of the Scottish Miners, from the Earliest Times,* (Allen & Unwin, 1955).

Page-Arnot R, *The Miners in Crisis and War, History of the MFGB from 1930 Onwards*, (Allen & Unwin, 1961).

Penn R & Simpson R, 'The Development of Skilled Work in the British Coal Mining Industry, 1870-1985', *Industrial Relations Journal*, 17, 4, (1986), pp 339-349.

Redmayne R A S (Sir), *Men, Mines and Memories*, (Egrie & Spoodieswood, 1942).

Redmayne R A S (Sir), *The Problems of the Coal Mines*, (Egrie & Spoodieswood, 1945).

Renfrew S, Militant Miners? Strike activity and industrial relations in the Lanarkshire coalfield, 1910-1914, in W Kenefick & A J McIvor (eds), *The Roots of Red Clydeside, 1910-1914, Labour Unrest and Industrial Relations in West Scotland*, (J Donald, Glasgow, 1996).

Rhodes E C, 'Output, Labour and Machines in the Coal Mining Industry in Great Britain', *Economica*, New Series, Vol XII, No 45, (1945), pp 101-110.

Slaven A, *The Development of the West of Scotland, 1750-1960,* (Routledge & Kegan Paul, 1978).

Smith B, *Seven Steps in the Dark, A Miner's Life*, (Luath Press Ltd., Barr, Ayrshire, 1991).

Supple B, *The History of the British Coal Industry, Vol 4, The Political Economy of Decline 1913-1946*, (Clarendon Press, Oxford, 1987).

Taylor A J, 'Labour Productivity and Technical Innovation in the British Coal Industry, 1850-1914,' *EHR*, Vol XIV, (No. 1), (1961), pp 48-67.

Tolliday S & Zeitlin J, (eds), *The Power to Manage*, (Routledge, 1991).

Trist E L & Bamforth K W, 'Technicism: Some Effects of Material Technology on Managerial Methods and on Work Situation and Relations,' in Burns T, *Industrial Man*, (Penquin, 1969).

Wellisz S, 'Sstrikes in Coal Mining', *British Journal of Socoilogy,* Vol 4, (1953), pp 346-366.

Whiteside J, *Regulating Danger: The Struggle for Mine Safety in the Rocky Mountain Coal Industry*, (University of Nebraska Press, USA, 1990).

Youngston Brown A J, 'Trade Union Policy in the Scots Coal Field', *EHR*, Vol VI, No 1, (1953), pp 35-50.

Zeitlin J, 'Rank and Filism in British Labour History: A Critique', *International Review of Social History,* Vol 34, (1), (1989), pp 42-62.

Zeitlin J,'Rank and Filism and Labour History: A Rejoinder to Price and Cronin', *International Review of Social History,* Vol 34, (1), (1989), pp 89-102.

Zweig F, *Men in the Pits*, Left Book Club Edition, (Gollancz, 1948).

THESES AND DISSERTATIONS.

Bonsall P M, 'The Somerset and Lothian Miners, 1919-1947, Changing Attitudes to Pit Work in the Twentieth Century'. University of Warwick, Ph.D. thesis, 1990.

Corrins R D, 'William Baird and Company, Coal and Iron Masters 1830-1914', University of Strathclyde, Ph.D. thesis, 1974.

Greasley D G, 'The Diffusion of a Technology: The Case of Machine Coal Cutting in Great Britain, 1900-1938', Universlty of Liverpool, Ph.D. thesis, 1979.

Kenefick W, 'The Labour Unrest of 1910 to 1914, with particular reference to the Ardrossan Dock Strike, 1912-1913', University of Strathclyde, Unpublished Honours Dissertation, 1990.

Long P B, 'The Economic and Social History of the Scottish Coal Industry, 1925-1939, with Particular Reference to Industrial Relations', University of Strathclyde, Ph.D. thesis, 1978.

Walter M A, 'The Coal Miner this Century: Social and Economic Relationships in Light of Changing Labour Process', University of Keele, M.A. thesis, 1982.