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Scientia Canadensis
Canadian Journal of the History of Science, Technology and Medicine
Revue canadienne d'histoire des sciences, des techniques et de la médecine

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Volume 12, Number 2 (35), Fall–Winter 1988

URI: https://id.erudit.org/iderudit/800271ar
DOI: https://doi.org/10.7202/800271ar

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Publisher(s)

CSTHA/AHSTC

ISSN

0829-2507 (print)
1918-7750 (digital)

Explore this journal

Cite this article

McIntosh, R. (1988). “Grotesque Faces and Figures”: Child Labourers and Coal Mining Technology in Victorian Nova Scotia. *Scientia Canadensis*, *12*(2), 97–112. https://doi.org/10.7202/800271ar

Article abstract

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"GROTESQUE FACES AND FIGURES": CHILD LABOURERS AND COAL MINING TECHNOLOGY IN VICTORIAN NOVA SCOTIA

Robert McIntosh[1]

ABSTRACT
One consequence of the technological improvements in mining coal in the nineteenth century was the increased use of child labour in Canadian collieries. Focussing on the major coal-producing province of the period, Nova Scotia, this article outlines how techniques of mining introduced during Victoria's reign encouraged the employment of boys, and how subsequent innovations in mining technology reduced the demand for boy labour after the turn of the century.

RESUME
Une conséquence importante de l'innovation technologique dans les mines de charbon au 19e siècle a été l'usage accru des enfants comme source de travail productif dans les charbonnages canadiens. Fondé sur l'étude des mines de Nouvelle-Ecosse, cet article montre comment les technologies introduites au cours de la période Victorienne ont encouragé l'emploi de jeunes garçons et comment cette demande a ensuite diminué avec l'arrivée, au tournant du siècle, de nouvelle technologies.

Few people were left indifferent by the sight of large and growing numbers of boys labouring in the coal mines of Victorian Nova Scotia. The impression left on observers of child mine workers, though, changed perceptibly over the nineteenth century. Early Victorians emphasized the picturesque aspects of pit-blackened boys. A Montreal journalist, Andrew Spedon, visiting the Albion Mines in Pictou County in 1862, was struck by 'the grotesque faces and figures of the let-loose imps, their unearthly yells and gestures.' As the century approached its close, however, Victorians came to show far more sympathy for boys' experience of work in the coal pits. In 1891 an explosion at the Springhill mines brought another journalist, R.A.H. Morrow, to Nova Scotia's coal fields. He deplored the condition of pit boys:

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> Sitting so long alone in the darkness they become thoughtful, sober, sometimes melancholy. They go silently to their homes when they leave the mine; they do not stop to play tricks or joke with their fellows; they do not run, nor sing, nor whistle. Darkness and silence are always depressing, and so much of it in these young lives cannot help but sadden without sweetening them.

These contrasting views reflect a broader nineteenth century transition, by which Victorians came increasingly to define childhood in sentimental terms and, in so doing, to condemn child labour.[2]

At the same time that revulsion against child labour became widespread, the technological changes accompanying Canada's industrial revolution encouraged its use. Within the unregulated, competitive market economy of Victorian Canada, employers were pressed to reduce their labour costs by hiring low-wage children. Working class families, anxious to earn a living wage, put their children on the labour market at an early age. Because Victorians were slow to translate their sentimentalization of childhood into the legal proscription of child labour, the extent to which children were employed in nineteenth century industry was determined principally by the nature of industrial technology. If minors could be used without prejudice to productivity to perform work in place of adults, companies would opt to employ them.

The interrelation between technical change and higher levels of child labour was particularly evident in coal mining. Into the nineteenth century colonial mining called simply for mature labourers, men with the strength

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2 Andrew Leamont Spedon, *Rambles Among the Bluenoses; or Reminiscences of a Tour Through New Brunswick and Nova Scotia during the Summer of 1862* (Montreal, 1863), 192; R.A.H. Morrow, *Story of the Springhill Disaster* (St John, 1891), 293-4. Major Canadian studies on the redefinition of childhood in the nineteenth century include Neil Sutherland's *Children in English Canadian Society: Framing the Twentieth-Century Consensus* (Toronto, 1976) and Patricia T. Rooke and R.L. Schnell's *Discarding the Asylum: From Child Rescue to the Welfare State in English-Canada, 1800-1950* (New York, 1983). See also Rooke and Schnell, 'Childhood and Charity in Nineteenth-Century British North America,' *Histoire sociale/Social History* XV, 29 (May 1982), 157-80.

to pry coal from the seam with crowbars and to drag sleds piled with freshly-cut coal from the mine. The introduction of steam power into Nova Scotia mines in the late 1820s, however, revolutionized coal production. It permitted larger collieries and increased division of labour and the creation of an array of new mine jobs within a boy's competence. Among these new mine jobs, those associated with the transportation of coal underground were most significant for child labour. Throughout Victoria's reign, boys leading horses along subterranean passageways played a central role in producing Canada's coal. As collieries grew and underground roads lengthened, more boys entered the coal pits. In Nova Scotia, the principal coal-producing province of nineteenth century Canada, three hundred seventy-two workers under eighteen years of age were employed in 1870 and six hundred in 1880. Eight hundred boys were labouring in provincial mines at Victoria's death as a consequence of the technical 'improvements' in the mining of coal of the previous century.[3]

More significantly, the proportion of the mine work force comprised by boys also increased over this period. Because of uneven technical development in the provincial coal industry, aggregate statistics mask the full extent of the interrelation between technical innovation and increased levels of child labour. They do nonetheless indicate an upward movement until approximately 1890, whereby boys, barely present at early Victorian mines, accounted for approximately one worker in six over the generation following Confederation. Boys continued to account for ten percent of the Nova Scotian colliery work force in 1901; that figure had slipped to eight percent ten years later. The relation between changes in mining technology and levels of child labour is most evident if we examine large collieries such as Sydney Mines in Cape Breton County where technical innovation was extensive. Only a few boys worked at this colliery in the early 1830s;

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3 Statistics on boy labour are found in the annual report of the Nova Scotia Department of Mines [henceforth *Mine Reports*]. These reports were published annually in the *Journals and Proceedings of the House of Assembly of Nova Scotia*. Boys are defined in these reports as all mine workers under eighteen years of age. They were seldom younger than twelve. Our discussion of Victorian technical change cannot explain why jobs within any child's competence were performed exclusively by male children. See *Mine Reports*, 1870, 1880, 1900.

by the end of the decade they comprised ten percent of the mine work force. By 1858 the figure stood at eighteen percent; in 1890 it peaked at 26.5%. The level of child labour had fallen to sixteen percent in 1901 and to ten percent in 1911. These trends in the extent of child labour are primarily attributable to changing mining techniques.[4]

Technical innovation in mining coal followed on the sharply-increasing demand in the nineteenth century for this long familiar commodity. Coal's importance to industrializing society was such, declared one Victorian panegyrist, that it served as 'the mainspring of our civilization'; it represented 'the highest material boon that can be craved by a community or nation.' Canadian annual consumption increased from perhaps three-quarters of a million tons at Confederation to three and a half million tons in 1886 and to nearly six million tons a decade later. As national markets grew, so did Canada's coal industry. Coal output increased from less than ten thousand tons in 1800 to nearly six million tons one hundred years later. Techniques of mining coal were transformed over this period as entrepreneurs sought to profit by rapidly-expanding markets. 'It may be truly said', marvelled Nova Scotia's Inspector of Mines James McKeagney in 1859, 'that this is the age of improvement.'[5]

Growing corporate demand for boys was met by British immigrant miners to Nova Scotia who imported longstanding traditions of child labour in the mines. For the miner, the entry of his son into the colliery helped him to meet household expenses; it was also the beginning of the boy's 'apprenticeship' to his likely occupation as an adult. For the employer in an industry as labour-intensive as coal mining, where his wage bill regu-

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4 *Mine Reports, passim.*; Public Archives of Nova Scotia [henceforth PANS], RG 21, Series 'A', Vol. 40, No 10, 'Particulars of Mining Operations in Cape Breton, 1832'; PANS, RG 1, Vol. 463, Nos 32-33, 'Statement of Men, Horses, and Machinery employed at Sydney Mines and Bridgeport Mines in September 1838,' cited in Stephen John Hornsby, 'A Historical Geography of Cape Breton Island in the Nineteenth Century' (PhD dissertation, University of British Columbia, 1986), 164; *Mine Reports*, 1858, 1890, 1901, 1911.

5 Cited in George H. Dobson, *The Coal Industry of the Dominion* (Ottawa, 1879). The estimates on coal consumption are taken from Edwin Gilpin, 'Coal Mining in Nova Scotia,' *Transactions of the Canadian Society of Civil Engineers* II (1888), 383 and a pamphlet in the National Archives of Canada Library, Anon., *Importance of the Canadian Coal Industry* (1897). Production figures are taken from W.F. Carroll, *Report of the Royal Commission on Coal, 1946* (Ottawa, 1947), 61 and from the *Mine Report* for 1901, xv; McKeangney, *Mine Report*, 1859, 290.

larly totalled two-thirds or more of his costs of operation, poorly- paid children were particularly attractive as workers. Although only scattered wage figures are available before the 1880s, a persistent gap between boys' and adult labourers' pay is evident. Adolescent horse drivers, for instance, earned forty cents per day in 1850 whereas the pay of adult labourers started at sixty-five to seventy cents daily. A generation later similar differential rates of pay remained. An adult labourer in the Nova Scotian mines was paid at a rate of ninety-five cents daily; the average boys' rate was sixty-five cents; and the youngest might earn forty cents daily. Employers hard pressed to reduce their labour costs welcomed any innovation in mining which encouraged the employment of boys while maintaining, or improving, levels of productivity.[6]

The capacity to introduce new means of mining coal was shaped in the first instance by financial constraints. Large investment of capital in Victorian Canada was limited by uncertain foreign markets, seasonal production -- coal could be shipped only during those months of the year when ports were ice free -- and by a tenuous hold on domestic markets even after the National Policy tariffs of 1879 and 1880. The General Mining Association (GMA) after 1826 and the Dominion Coal Company from 1893 were the two principal nineteenth century investors in Nova Scotian coal mining. The GMA enjoyed a monopoly of provincial coal production from its arrival until 1858; even afterwards, it remained a major coal producer until 1900 when it sold the colliery at Sydney Mines, its last Nova Scotian property. Dominion Coal brought under one corporate umbrella the numerous Cape Breton South collieries and from its organization was the dominant coal producer in the province. Each company represented a benchmark in the history of coal mining technology in Nova Scotia. The GMA introduced steam power to provincial collieries; Dominion Coal was the major late nineteenth century innovator in mine mechanization.[7]

The coal industry in Victorian Canada, like other colonial industries, relied heavily on techniques of mining coal pioneered elsewhere, primarily in Great Britain. Although important recent studies of industrial technology focus on the means by which foreign technology was adapted to Ca-

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6 Wage rates are drawn from Walter R. Johnson, *The Coal Trade of British America* (Washington, 1850), 16-17, 20 and from C. Ochiltree MacDonald, *The Coal and Iron Industries of Nova Scotia* (Halifax, 1909), 45.

7 See D.A. Muise, 'The General Mining Association and Nova Scotia's Coal,' *Bulletin of Canadian Studies* VI, 2/VII, 1 (Autumn 1983), 70-87; Don MacGillivray, 'Henry Melville Whitney Comes to Cape Breton: The Saga of a Gilded Age Entrepreneur,' *Acadiensis* IX, 1 (Autumn 1979), 44-70.

nadian needs, the emphasis here is on the 'borrowing' rather than on Canadian adaptations. It was not the local modifications of borrowed mining technology which encouraged child labour but the borrowed techniques themselves. The transfer of technical expertise in mining occurred at three levels. Indispensable to the adoption of new technologies was the availability of capital. The British mine officials (managers and engineers) retained by these companies brought a technical knowledge of mine structure and mechanization to Nova Scotia. Finally, the British miners who dominated the Victorian mine work force carried with them a practical knowledge of the safe, efficient extraction of coal.[8]

Despite the technical transformations which nineteenth century Canadian coal mines underwent, the basic form of the colliery remained unchanged, and colliery workers continued to perform four basic activities. Development work at a new mine began with the sinking of a vertical shaft or diagonal slope from the surface into the coal seam. From the base of the slope or shaft the major underground passageways - the levels - extended into the seam. At larger mines, several levels might be used, each intersecting with the slope or shaft at a different depth underground. Some collieries worked several different coal seams in this manner. Off each level, a variety of auxiliary roads led at right angles to the working places or 'bords', each of which was separated from the next by a solid pillar of coal. This method of mining, labelled 'bord and pillar', produced the checkered pattern characteristic of Victorian collieries.

Within this workplace four principal tasks were performed. These included:

1) the actual mining of the coal in the various bords;
2) the transportation of the coal out of the mine;
3) the maintenance of the mine; and
4) surface work in the 'bankhead' where coal was prepared for and shipped to market.

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8 Elwood Moore, *American Influence in Canadian Mining* (Toronto, 1941), is representative of an earlier school of writing on the history of technology in Canada which stresses Canadian 'borrowing' of foreign 'inventions'. More recent literature has placed greater emphasis on Canadian initiatives in technology. See, for instance, Dianne Newell, *Technology on the Frontier: Mining in Old Ontario* (Vancouver, 1986) and Donald E. MacLeod, 'Miners, Mining Men and Mining Reform: Changing the Technology of the Nova Scotian Gold Mines and Collieries, 1858-1910' (PhD dissertation, University of Toronto, 1981).

While the means of removing coal from the seam changed in the course of the century, the dispersion of mining in dozens of distinct bords continued as long as 'bord and pillar' techniques were employed. It was incumbent upon underground transportation systems to 'keep pace' with the output from these numerous bords. As mines grew larger, this task became more difficult. Generally these systems contained two distinct elements. Underground haulage refers to the movement of coal from the bords to the base of the mine shaft or slope. Hoisting brought the coal to the surface. Among the various activities associated with the maintenance of a mine, two were most significant. Ventilation systems functioned to bring fresh air to the mine workers and to dissipate noxious and/or explosive gases. Pumps were necessary to keep the working places free of water. If mining extended under the water table some means of removing pitwater was indispensable. Surface work involved the transfer of coal from the vehicles in which it was transported out of the mine into the ship, rail car or cart which brought it to the consumer. Before shipment from the colliery, the coal was 'prepared'; it might be cleaned by removing by hand visible impurities and/or sorted on the basis of size.

The nature of these activities changed radically in the course of the nineteenth century. As late as the 1820s, mines remained shallow and short lived. Coal was cut and pried from the coal face with handpicks and crowbars, explained a colonial mine manager, 'by "holing" across the bord in the middle, "sheering" the sides, and breaking it down by wedging.' At the largest colonial mine – at this time, Sydney Mines – the work of transporting the coal underground was performed by 'strong, active young men' who pulled 'skips', 'a sled with runners', on which tubs filled with coal were placed. The roadbed consisted of 'round poles, two to three inches in diameter, laid transversely, close together.' When underground haulage roads at one shaft became too long, it was abandoned and a new one sunk elsewhere. In Cape Breton, shafts were spaced at approximately two hundred-metre intervals. Problems of hoisting coal, of ventilation and of pumping water from the workings limited mine depth to perhaps fifty metres. Coal was raised by a system of rope and pulleys which was powered by horses and labelled the 'horse-whim'. Little attempt was made to ventilate these mines. Some effort might be made to drain pitwater by drilling 'adits' (tunnels) if this were possible (if, for instance, the mine was situated

at the seaside). The work force of these mines consisted of labourers who did work calling for an adult's strength. They performed a variety of mine jobs during any given pay period, not specializing in any single activity. The physical demands placed on these workers discouraged the employment of children.[9]

The most striking change in nineteenth century coal mining was the steady increase in colliery size, a process attributable to the successful application of steam power to mining. Its development in Britain over the eighteenth century had removed major bottlenecks to the production of coal. Newcomen's engine had been tested by 1720; before the end of the century, the far more efficient Boulton and Watt engine was available to the mining industry. The limits placed on the depth of mining by the accumulation of water in the coal pit and by the difficulties associated with the removal of coal from deep workings were redrawn by the successful application to mining of the steam engine as a pump and hoist. The earliest steam-powered mines might extend to three hundred metres in depth or three thousand metres from the bankhead. By the end of the century, these limits had been pushed considerably further: the largest collieries might reach five hundred metres below ground or extend up to five thousand metres from the bankhead. The most advanced of Nova Scotia's mines participated fully in this growth. Indeed, the *Canadian Mining Review* claimed in 1902 that Dominion Coal's #2 mine was shortly to be the largest single producing shaft in the world.[10]

The greater scope of mining over the nineteenth century en-couraged increasing subdivision of the colliery labour force and the specialization of mine workers. This process produced a work force hierarchy, at the apex of which emerged a group of specialists expert in the efficient production of coal in the bords. These were the coal 'cutters' or miners proper. In the process of creating specialized miners, a variety of new mine jobs which did not place significant demands on individual skill, strength or experience emerged. In short, the door was opened to the extensive employment of children. A basic division emerged within the work force distinguishing those labelled 'skilled', the coal cutters and handful of tradesmen such as

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9 Richard Brown, *The Coal Fields and Coal Trade of the Island of Cape Breton* (Stellarton, 1899), 51-2; Gilpin, 'Coal Mining in Nova Scotia,' 395; Hugh Millward, 'A Model of Coalfield Development: Six Stages Exemplified by the Sydney Field,' *The Canadian Geographer* 29, 3 (1985), 239.

10 See Millward, 'A Model of Coalfield Development,' 239, 243; *Canadian Mining Review* XXII (January 1903), 2.

carpenters, machinists and blacksmiths employed at each colliery from the 'unskilled' mine workers, those who did the work associated with transportation of coal to the surface, mine maintenance and preparation of coal for shipment to market.

After extensive subdivision of the Victorian mine work force, clear limits emerged governing the usefulness of boys. At highly-developed Victorian collieries such as Sydney Mines, for instance, approximately two-thirds of all underground workers were miners. Because boys never performed work considered skilled, the crucial changes in mining technology concern the means by which work labelled 'unskilled', or one-third of all underground work, came within a child's competence. Because the single largest group among unskilled mine workers comprised those involved in transporting the freshly-cut coal from the bords to the mine slope or shaft, underground haulage provides the best single index of the interrelation between changes in Victorian coal mining techniques and levels of child employment.[11]

It was the GMA which enabled the Nova Scotian coal industry to move beyond primitive means of coal extraction and adopt advanced early Victorian mining techniques. With the arrival of this company in the late 1820s, the process of mine mechanization and the subdivision of labour was rapidly underway. According to two contemporary reports, GMA investment in Nova Scotia stood at 300,000 stg before 1846 and at 400,000 stg by 1849. Large collieries were established at the Albion Mines and at Sydney Mines. The latest British mining techniques, including steam power, were rapidly adopted in the province. On the mine surface, arrangements for the transportation of coal from the pithead to the wharf were revolutionized by the introduction of steam locomotives. Gunpowder, just coming into general use in British mines, was introduced to Nova Scotia. While the handpick remained indispensable to 'sheering' and 'undercutting' the coal face, the use of gunpowder to dislodge the remain-

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11 At Sydney Mines in 1858, 192 of 276 workers underground were coal cutters; in 1880, 221 of 333; in 1900, 336 of 478. See *Mine Reports* for 1858, 1880, 1900. Not all drivers were under eighteen years of age, but manuscript census data from Sydney Mines in 1891 indicates that approximately seventy percent met our definition of 'boy'. The balance were overwhelmingly eighteen or nineteen years of age. See National Archives of Canada, RG 31, Mss. Census, Sydney Mines, 1891.

ing coal increased the miner's productivity by perhaps forty percent. Methods of hoisting coal from the pit were vastly improved with steam power replacing the 'horse-whim'. Shafts were able to penetrate far deeper underground. One was sunk in 1830 to 200 feet; another in 1834 to 320 feet; a third in 1854 to 400 feet; and another in 1868 to 840 feet.[12]

At the GMA collieries, a range of boys' jobs emerged. The youngest boys often entered the mine as 'trappers', opening and closing large ventilation doors used to channel air through these larger mines. The oldest boys could work as miners' helpers, assisting them with a variety of tasks in the bords, including the loading of coal tubs. A number of odd jobs around the mine such as distributing miners' lamps and picks or greasing the axles of coal tubs were done by boys. The majority of boys, though, laboured at the underground haulage of coal: the 'typical' colliery boy was the horse 'driver'. It was the widespread use of horses in GMA mines which opened the way to the employment of large numbers of boys.

The potential boost to mine productivity which other GMA innovations represented were only realized if simultaneous improvements to the transportation of coal underground were made. From their introduction in British collieries in the eighteenth century, horses (or, less often, ponies or donkeys) had been used underground to pull tubs laden with coal. When the GMA entered the colonial coal fields, it adopted what was generally perceived as the best mining practice of the day and adopted horse haulage, supplemented wherever possible by a variety of labour-saving techniques. Initially horses continued to pull 'skips', but these had been gradually displaced by 1852 by wooden coal 'tubs' or 'boxes' bolted to an iron frame and designed to run over underground rails. While at smaller mines wooden rails might be used, generally they were made of iron. By 1871 the GMA had in place several miles of light underground railway 'with a full equipment of coal tubs and trams, at each colliery.' The company owned about one hundred twenty horses that year, of which three-quarters were employed underground. These accounted for about half of the total number of horses used in provincial mines. Coal companies enlarged or reduced their complement of horses as demand for coal fluctu-

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12 Brown, *Coal Fields*, 77; Abraham Gesner, *The Industrial Resources of Nova Scotia* (Halifax, 1849), 286; Edwin Gilpin, 'Coal Mining in Pictou County,' in *Transactions of the Royal Society of Canada* IV (1896), 172-3; B.R. Mitchell, *The Economic Development of the British Coal Industry 1800-1914* (Cambridge, 1984), 75-6; Brown, *Coal Fields*, 63-4; New Glasgow *Eastern Chronicle*, 25 January 1868.

ated. The ease with which this was done accounts for the attractiveness of horse haulage for mine managers.[13] The history of child labour in the Nova Scotian mines does not correspond with the familiar images of young children crawling along subterranean passageways, dragging sleds with a 'guss' (a girdle and chain) attached to their waist. These portraits, given wide publicity by officials of the 1842 British Children's Employment Commission anxious for Parliament to act to restrict child labour, convey a misleading impression of child mine work. They portray very inefficient methods of removing coal from the mines. Mine managers had every reason to use other means of underground haulage.[14]

Although horse haulage remained the principal means of trans-porting coal underground until the turn of this century, there were three ways in which it was commonly supplemented in GMA and, after 1858, other provincial mines. Where seams pitched steeply, use was made of gravity. If the grade was sufficiently steep, freshly-cut coal would be brought down to the travelling roads by the use of slides or 'shoots'. If the grade was not quite steep enough, boys called 'shovers down' were employed. By lifting a door at the mouth of the 'shoot', the driver filled a tub with coal. These were in use at Springhill in Cumberland County as late as 1922. The 'back-balance' also made effective use of gravity. Two mine cars, one of which carried ballast, were put around a pulley placed at the top of an inclined underground road. By the use of a lever the empty car was brought to any point along the 'incline' where it could be removed to the bords. When filled with coal, the car was returned to the 'back-balance'. Gravity would lower the car to a principal underground road where it could be attached to a horse. A 'back-balance' was in use at the Albion Mines in 1865 where it was estimated that one boy, over a ten-hour shift, could 'brake down' two hundred seventy-five to three hundred boxes of coal, each of which weighed fifteen hundred pounds. By the early 1870s, these were also in use at a number of Cape Breton mines. As more advanced methods of moving coal were introduced into Nova Scotian collieries,

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13 Gilpin, 'Coal Mining in Nova Scotia,' 395; Brown, *Coal Fields*, 113.

14 See Neil K. Buxton, *The Economic Development of the British Coal Industry: From the Industrial Revolution to the Present Day* (London, 1978), 27; Mitchell, *Economic Development*, 101.

boys came to work with these also. Steam engines were first used underground in the 1850s to hoist coal tubs up underground inclines.[15]

As late Victorian mines grew in size, underground roadways lengthened and mine managers looked not simply to supplement but to replace horse haulage. Not only were horses exhausted by the long distances but expenses associated with the maintenance of underground roads multiplied. Efforts had to be made to keep them well drained because pit water, particularly corrosive in Cape Breton because it was salt water, ingaggravated any cuts in the base of the horse's hoof. 'Roof-brushing' - raising the level of the roof to permit the passage of horses - became increasingly costly in lengthy underground travelling ways as did roof-buttressing, the placing of wooden props at regular intervals. The rails had to be well ballasted. Otherwise, horses, not to mention their drivers, risked injury. If the work of driving a horse was perceived to be within a boy's competence, a continual record of dead and injured boys indicates something of its rigour. Driver James McPherson broke his collarbone in 1890 when a box of coal capsized on top of him. That same year another boy, William Dunbar, was 'severely hurt' when kicked by a horse. In one of the most common mine accidents, driver Joseph McLellan was 'killed by a roof stone falling on him' in 1900.[16]

For a number of reasons, consequently, Victorian mining engineers sought a superior means of underground haulage. The first important innovations in this area, pioneered in Great Britain, were based on the systematic use of steam. Although steam engines had been used to a limited extent underground in Britain from the turn of the nineteenth century to haul coal tubs up inclines, their wider employment underground was restricted principally because of problems of transmitting power. With the introduction of wire ropes underground in the 1840s, these problems were largely overcome. A number of new haulage systems were developed in Britain at this time with three varieties of mechanized rope haulage coming into widespread use. With 'main rope' (or direct) haulage, steam power was used to pull loaded tubs up an underground railway which was suffi-

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15 J.C. Nicholson, 'Past and Present Methods of Mining No. 2 Mine, Springhill, Nova Scotia,' *Canadian Mining Journal* (1922), 468-70; Gilpin, 'Coal Mining in Nova Scotia,' 357-9; Geological Survey of Canada, *Reports on Progress*, 1866-7, 94; *Mine Reports*, 1874, 1875; Gilpin, 'Coal Mining in Pictou County,' 175; see also PANS, RG 21, Vol. 38, No 14, 'Richard Brown Diaries,' entry for 16 February 1901.

16 C.B. Kingston, 'The International Colliery,' *Transactions of the Canadian Society of Civil Engineers* V, 1 (January-June 1891), 21; Edwin Gilpin, *Notes on Nova Scotia Pit Waters* (Halifax, ca 1877); *Mine Reports*, 1890, 1900.

ciently steep to allow the empty tubs to run back by gravity. 'Main and tail' haulage was identical except that 'trips' or groups of tubs could be pulled up a travelling way and also, by virtue of a pulley at the end of the line opposite the engine, back down. This was necessary, for instance, when roads undulated. The third system of underground haulage developed at this time - 'endless rope' - was attractive to mine managers because it required half the manpower of the other two rope systems with which a worker stood idle until a trip returned to him. Its principal drawback was that it required a double track because the rope to which 'trips' could be attached at any point travelled 'endlessly' around a narrow, oval-shaped course. For this reason endless rope was most commonly used on the major underground roadways - the levels.[17]

Although means of mechanizing underground haulage were available and familiar to the British-educated mine officials in Nova Scotia, these techniques were not readily adopted in the province. They were costly: to the expense of the machinery had to be added the cost of preparing the roadway. To a greater extent than with horse haulage, mechanized haulage demanded straight and well-ballasted roads. Moreover, existing systems of underground haulage were perceived by managers to be adequate to the demands placed on them. Indeed in Britain itself debate over the relative advantages of horse and mechanized haulage continued over the second half of the nineteenth century, although it became increasingly apparent that on main roads rope haulage was to be preferred. As a rule, B.R. Mitchell has argued that the larger the quantity of coal to be moved, the longer the distance and the steeper the inclines, the more evident the advantages of mechanical haulage. At the same time, even in Britain auxiliary roads were seldom mechanized. In some instances thin seams required coal tubs to be pushed by a young worker; more often, it was simply more economical to continue to use the flexible horse haulage.[18]

The principal impediment to major technical innovation in the Nova Scotian coal fields was the weak financial structure of the industry. Ownership was dispersed and competition fierce throughout much of the second half of the nineteenth century, after the termination of the GMA monopoly. 'The coal operators in this district [Cape Breton]', wrote the editor of the *Canadian Mining Review* in 1893, 'have for thirty years pursued an un-

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17 Mitchell, *Economic Development*, 77; *Historical Review of Coal Mining* (London, c.1924), 94-8; William Blakemore, 'The Introduction of Endless Haulage into Cape Breton,' *Canadian Mining Review*, 1894, 151-4.

18 Mitchell, *Economic Development*, 78-9.

deviating policy of cutting one another's throat, until one wonders there is anything left of them.' Edwin Gilpin, Nova Scotia's Inspector of Mines, argued in 1888 that in these circumstances, technical innovation was seriously curtailed. To enable 'modern appliances' to be introduced, he claimed, provincial mines had to be brought under 'one management.' Steps to this end were taken late in the century. Three Pictou County collieries had amalgamated in 1886 as the Acadia Coal Company, and the important Cape Breton South coal field was organized under the aegis of the Dominion Coal Company in 1893.[19]

The strengthened financial structure of the coal industry permitted the extensive mechanization of provincial collieries. Both trends were encouraged by strong turn-of-the-century markets for coal. Techniques of mining coal were rapidly transformed in the period prior to World War I, particularly at Dominion Coal's collieries. On the surface, improved rail and wharf facilities and machinery for the preparation of coal were installed. Underground, the new techniques of mechanical cutting and conveyance of coal were widely adopted, once again bringing Nova Scotian mines to world standards. Although a British invention, first having been tested as early as 1861 at a colliery in West Yorkshire, the mechanical coal cutter saw its widest application in North America. In 1902, seventy-six percent of Dominion Coal's output and forty-nine percent of the province's was machine-cut. In the United States the figure stood at twenty-five percent and in the United Kingdom at two percent. The laborious task of undercutting coal by handpick might take the miner anywhere between three and six hours, before the coal face was prepared for a charge of gunpowder. By machine, perhaps one-quarter of this time was needed. The production of coal at the face increased sharply.[20]

For coal companies to reap the benefits of mechanization at the coal face, better means of underground haulage were required, although the pressure on haulage systems was muted somewhat by the bottleneck the continuing

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19 Quoted in Don MacGillivray, 'Henry Melville Whitney Comes to Cape Breton,' 52; Gilpin, 'Coal Mining in Nova Scotia,' 388.

20 On the adoption of mechanical cutters, see J.G. Hudson, 'Notes on Coal Cutting Machinery at the Collieries of the Dominion Coal Company,' *Canadian Mining Review*, 1894, 156; Mitchell, *Economic Development*, 81-2; *Canadian Mining Review*, 1903, 59-60; Keith Dix, 'Work Relations in the Coal Industry: The Handloading Era, 1880-1930' in Andrew Zimbalist (ed.), *Case Studies in the Labor Process* (New York, 1979), 160-1. Curtis Seltzer, in *Fire in the Hole: Miners and Managers in the American Coal Industry* (Lexington, Ky., 1985), 12, estimates that undercutting machines reduced by seventy-five percent the time required to undermine a coalface by handpick.

need to load coal tubs by hand produced. Once again, mine managers had British inventions to draw on. The first system of mechanized rope haulage in the province was introduced in the early 1880s at the GMA colliery at Sydney Mines where the longest levels extended for more than a mile; at all other provincial mines, coal continued to be hauled on the levels by horses. By the early 1890s, however, rope haulage was commonplace in larger provincial mines. On the mainland these included endless rope systems on the main levels at Springhill and at the Drummond Colliery in Pictou County. By 1896 Dominion Coal used endless rope haulage at half a dozen Cape Breton mines. Rope haulage, in displacing horses, also displaced their adolescent drivers. Springhill's endless rope system '[did] away with a large number of horses'; it was reported that at the Drummond Colliery 'the management has curtailed boy and horse labour very much by a system of endless rope haulage underground which gives great satisfaction.' The mechanization of underground haulage at Sydney Mines, noted engineer John Johnson, 'has altogether done away with the necessity of employing horse drivers.' The erosion of employment levels from the 1890s in the major site of boys' work marked the reversal of the Victorian trend towards increased levels of child labour.[21]

The rapidity with which these new techniques of underground haulage were adopted throughout the province should not, however, be overstated. One of the most distinctive features of the coal industry was its uneven technical development. Although horses had been entirely removed from three pits at Sydney Mines by 1910, such mines were exceptional in Nova Scotia until the third or fourth decade of this century. Indeed, the last horse was not out of the Cape Breton mines until about 1960. Because the process of technical change in coal mining was protracted and uneven, boys might have laboured at traditional tasks until well into this century.[22]

Boys were nonetheless all but excluded from the provincial mine work force by the 1920s. To account for this, a number of other factors apart from technical change have to be taken into consideration. The 'peculiar social environment' of Victorian Canada, characterized by limited state involvement in the labour market, had begun to give way late in the century to a new regulatory regime of state-set employment standards, the earliest

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21 Gilpin, 'Coal Mining in Nova Scotia,' 363; Brown, *Coal Fields*, 143; *Canadian Mining Review*, 1896, 2-3/1893, 2/1891, 209; John Johnston, 'Description of Haulage System Installed to take the Place of Horses at No. 3 and No. 4 Collieries,' *Journal of the Mining Society of Nova Scotia* XV (1910-11), 92.

22 Johnston, 'Description of Haulage System,' 92; *Cape Breton's Magazine*, 32 (1983), 42.

of which focused on those workers perceived to be most vulnerable, *i.e.* women and children. Ironically, the coal industry, by highlighting the consequences of unregulated production in terms of child employment, hastened government action. It was no coincidence that in Canada the earliest legislation restricting child labour, a Nova Scotia act of 1873 establishing a minimum age of ten for workers, pertained to coal mines. 'The effect of employing boys of tender age in the mines under ground', argued the responsible minister in support of this act, 'was to make them stunted and demoralized by shutting them out from the influences of the free air and sunshine.' Mines legislation and early compulsory schooling laws had the effect of limiting the supply of the youngest children available for colliery work. In addition, at the turn of this century, a large influx of immigrants from southern and eastern Europe gave mine operators an alternative supply of low-wage, unskilled labour, thus weakening their opposition to child labour legislation. The supply of children was further eroded by an improved miners' income which reduced the family's need for their boys' wages. If the history of mining technology helps to explain why boys entered Victorian mines in large numbers, we must look elsewhere to account for their gradual removal from the mine early in this century.[23]

ACKNOWLEDGMENTS

I wish to express my gratitude to Rolina van Gaalen, Duncan McDowall and Del Muise for their comments on earlier drafts of this paper and to the Social Sciences and Humanities Research Council of Canada for the doctoral fellowship which enabled me to undertake this research.

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23 House of Assembly of Nova Scotia, *Debates and Proceedings, 1872* (Halifax, 1873), 258. For a discussion of the impact of legislative restrictions on child labour in the Nova Scotian mines, see Robert McIntosh, 'The Boys in the Nova Scotian Coal Mines, 1873 to 1923,' *Acadiensis* XVI, 2 (Spring 1987), 35-50.