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Volume 5, 1980

URI : <https://id.erudit.org/iderudit/11t5art05>

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Éditeur(s)

Canadian Committee on Labour History

ISSN

0700-3862 (imprimé)

1911-4842 (numérique)

[Découvrir la revue](#)

Citer cet article

Clement, W. (1980). The Subordination of Labour in Canadian Mining.
Labour/Le Travailleur, 5, 133–148.

The Subordination of Labour in Canadian Mining

Wallace Clement

THE PAST century has witnessed two fundamental changes in Canadian mining's class relations. Around the turn of the century there was the transformation from petty commodity to capitalist relations of production representing the formal subordination of labour. More recently there has been the real subordination of labour accomplished by transformations within the capitalist mode of production. Both resulted in radical reorganizations of the social relations of production and were carried out with the infusion of large amounts of capital and technology. The first change, from owner-operated mining to capitalist control, was accomplished by capitalist ownership of mining sites. The second change is characterized by mechanization of underground operations and automation of surface plants, reducing the amount of direct labour required and the autonomy of the remaining mine workers, thus increasing the direct control of capital over the labour process.

This paper will analyse the impact of technology on the nature of work in mining, focusing on the implications for the number of workers required and their skill levels. In the analysis of the first change from petty commodity to capitalist production, we will briefly examine mining historically, while in the second change we will concentrate on recent transformations in the underground and surface operations of Inco Limited, Canada's largest mining company.¹

¹ This paper draws upon a thread of argument contained within my larger study, *Hard-rock Mining: Industrial Relations and Technological Change at Inco* (Toronto 1980) which documents changes in the technology of mining and the labour process only touched upon here. The purpose of this paper is not to provide a history of mining, or even a survey of the labour process in that industry. Rather, it is to make a specific argument about changes in the labour requirements within the industry as it progresses through various relations of production.

Wallace Clement, "The Subordination of Labour in Canadian Mining," *Labour/Le Travailleur*, 5 (Spring 1980), 133-148.

I. Introduction

PROPERTY relations involve a series of rights which determine control over various aspects of production.² Independent commodity producers control for example, access to the means of production, their own labour power, the products of their labour, and the way they organize the labour process. With the subordination of petty commodity production by capitalist relations these rights are eroded. A transformation results under capitalist relations, as Guglielmo Carchedi has argued, from the formal subordination of labour to real subordination. Formal subordination of labour means that only the products of labour are appropriated by capital while the prior technological conditions of production remain intact; that is to say, "At first, capital subordinates labour on the basis of the technical conditions in which it historically finds it."³ Real subordination means the labourer is stripped of control over the products of his labour but also of control over the way his labour power is utilized in the social organization of work. Workers are transformed into "collective labourers" and subjected to a detailed division of labour.⁴ This process is accomplished, Marx argued, by the "decomposition of handicrafts, by specialization of the instruments of labour, by the formation of detail labourers, and by grouping and combining the latter into a single mechanism."⁵ Thus workers are stripped of the rights of property associated with petty commodity production only partially eroded with the formal subordination of labour and are left with only detailed labour to perform. Capital appropriates all the rights of property and uses technology to subject the labour process to minute units devoid of previously acquired skills.

In Canadian mining the formal subordination of labour occurred very rapidly, cutting short the independent commodity producer's premier place within the industry.⁶ Formal subordination was accomplished primarily by capitalists gaining control over access to mining property by having the state transform mining areas from common property available to anyone to private property which the capitalists could appropriate.⁷ The real subordination of

² For a discussion of this point, see Wallace Clement, "Class and Property Relations: A Preliminary Exploration of the Rights of Property and the Obligations of Labour," a paper presented to the International Structural Analysis Colloquium on "The State and the Economy," University of Toronto, 6-9 December 1979.

³ Karl Marx, *Capital*, I (New York 1967), 310.

⁴ See Guglielmo Carchedi, "Reproduction of Social Classes at the Level of Production Relations," *Economy and Society*, 4 (1975), 14-16, and his *On the Economic Identification of Social Classes* (London 1977), 53-55.

⁵ Marx, *Capital*, I, 364.

⁶ See Wallace Clement, "Class Transformations in Mining: A Critique of H.A. Innis," in Mel Watkins, ed., *The Legacy of Harold Innis* (Toronto 1980).

⁷ See Harold A. Innis's documentation of the development of mining exchanges and state regulations providing long-term leases on large mining areas requiring heavy

labour in mining has, however, been a longer process. Control over the labour process within the mines has been accomplished primarily by the introduction of capital-intensive technology and training methods which dramatically reduce workers' autonomy and bring them directly under the control and supervision of capital. While mechanization has been the principal expression of capitalization underground, in surface operations the change has been toward greater automation; that is, interdependent control systems which involve both electronic machines directing other machines to perform pre-determined tasks, thus minimizing workers' intervention, and the centralization of reporting control information. Mechanization and automation have altered the skill levels of mining workers and made possible their loss of control over the production process. In both settings capitalization has decreased the amount of "bull-work" or heavy labour performed but it has also decreased the requirement for craftsmen and tradesmen within the mining industry. The mechanization of mines and automation of surface plants has been an important dimension of management's strategy to contain labour in what has always been a militant fraction of the working class. Additional strategies not to be discussed in detail here have included internalization of mine production centres and diversification of profit centres.

In response to the militancy of Canadian labour, cyclical shortages of labour and threats to its control over the international nickel market, Inco embarked on a multi-pronged strategy to enhance its profitability in the late 1960s. Its program of internationalization meant the development of laterite ores in Indonesia (at a cost of \$850 million) and Guatemala (\$235 million). Its diversification program included purchases of ESB Limited, the world's largest battery manufacturer (\$241 million), as well as investments in a rubber company, a machinery company, an energy company, and an investment company, all designed to reduce its dependence on the metal mines industry (hence the workers in that industry).

The thrust of this paper, however, is to explore the implications of capitalization for workers within the mining industry as they are expressed in new types of technology and the re-organization of work. The forces of production are related to the relations of production in such a way that capital dominates labour and uses technology and the organization of work to reinforce its control to facilitate capital accumulation. Production is both a technical and social process in which the social dominates the technical. Decisions governing the introduction of technology are determined by profitability (a social imperative for capitalists) and require being able to induce workers to accept them. It will be argued that the relation between the social and technical aspects of production presented here explains the development of class relations within Canadian mining.

II. Petty Commodity to Capitalist Relations

IN CANADA the historical moment of petty commodity production in mining was relatively brief. Part of the reason for its rapid demise was the existence elsewhere of capitalist mining which rapidly penetrated this activity in Canada, sometimes directly through branch plants and sometimes mediated by indigenous capitalists expanding their activities. The relationship between capital and technology is at the heart of the transition from petty commodity production and the realization of capital's success was made possible by favourable state policies. It is important to establish the relationship between capital and technology. Large amounts of capital are required to develop and, more importantly, to implement sophisticated technology in large-scale capitalist production. Since only the largest capitalists have access to such large capital pools, either internally generated or from outside financial sources, large capital tends to monopolize the benefits of technological advance. This advance tends at the same time to undercut the relative productivity of earlier forms of production. Further prerequisites to capitalism are control over the factors of production (in this case, mine sites) and the availability of labour unable to seek out its own means of production. Both of these conditions were met by the destruction of petty commodity mining and aided by state policies.

The gold rushes on the west coast between 1863 and 1898 were the heyday of petty commodity production in Canadian mining. Land for mining was readily available and only rudimentary technology was required for production, primarily in the form of "hand-picking." Miners typically worked in pairs. Once they located a pay-streak in a creek bed they would remove gravel along the shore and dig a shaft to the source of the gold-bearing ore. Drifts (parallel shafts underground) would then be made along the vein of ore by using picks and shovels. The ore would then be hoisted to the surface by hand. It was placed into sluice boxes to wash out the gold. Sluicing required access to large quantities of water and provided the first area for capitalist penetration, since capitalists were often able to gain control over water supplies.

The major toe-hold of capitalist penetration occurred, however, through the development of a speculative market in mine stakes and the emergence of a mining exchange to auction claims. This market made it possible for capitalists to concentrate many claims under their ownership. The high cost and scarcity of labour in the area, however, prevented the widespread use of wage labourers. Instead a "lay system" was created. It was a transitional form of production between petty commodity relations and capitalist relations of production. Formal subordination occurred in the sense that capitalists owned the claims but let them out to miners who worked the claims using the same techniques as before. The miners covered all the costs of production while the owner paid the royalties and received half the gross output of the mines, the other half going to the miners. During the height of the gold boom of 1897-98 in the Klondike

region, the lay system accounted for three-quarters of all claims.⁸

After the construction of railways into the region, heavy equipment was introduced in the form of mechanical dredges. These dredges allowed capital to eliminate the lay system and create one based on wage labour. As a result of the dredges the cost of moving a cubic foot of gravel was cut in half between 1899 and 1903, thus the premium on labour was reduced. The introduction of mechanical dredges in 1900 meant that three men could perform the labour of 156 men using hand methods. Each dredge cost \$300,000 in 1905 thus making possible the monopolization of production by a few large firms.⁹

The removal of ore from alluvial soils along creek beds by placer mining encouraged petty commodity production, but such primitive techniques could not withstand competition with capital-intensive ones. Lode mining, in which ore is removed from hard-rock underground, encouraged capitalist relations from the outset because of the high capital costs involved. Initially lode mines did not use wage labour. Throughout the mining industry — in coal, copper, nickel, zinc, and silver mines — a contract system of employment developed. Miners were paid either by the amount of ore removed (tribute-work) or ground cut (tutwork). In a sense, they sold the products of the mines to the mine owners. Miners worked in pairs or small groups and organized their own production. Coal cutters, for example, were paid by the box of coal and hired their own loaders and checkweighmen. The mine owners furnished the tools, but the miners had to pay for their own blasting powder.¹⁰ Although the contract system common throughout mining gradually gave way to wage labour supplemented by bonus payments for output above a minimum amount of production, the miners continued to retain a good deal of autonomy in their organization of work underground.

These systems combined elements of both petty commodity and capitalist production but the direction of the relations of production was clear. The capitalists owned the mines and their products; the workers worked "for themselves," yet did not own the means of production. Today many remnants of these earlier systems persist in mining. There is still a bonus system distinct from hourly wages, as well as a "loose" supervisory system, and miners still control the organization and pace of their work. Recent developments, to be discussed shortly, are beginning to strip away these remnants and complete the real subordination of labour in mining.

Particular technology is not necessarily capitalist; it becomes so only under certain social relations. A sluice box (used to separate rock from minerals by passing water over ore) is, for example, as easily the equipment of petty commodity producers as the capital of a capitalist. It is reasonable to assume, however, that once the equipment or machinery (such as a mechanical dredge)

⁸ *Ibid.*, 207.

⁹ *Ibid.*, 223-224.

¹⁰ Greg Kealey, ed., *Canada Investigates Industrialism* (Toronto 1973), 404-442.

reaches a certain scale and cost, requiring more than a handful of men to operate and hundreds of thousands of dollars, then it cannot be utilized under petty commodity class relations. It must either become the common property of all those using it, as in co-operative ownership, an unusual development under capitalist dominated social relations, or more probably it will become the property of capitalists who in turn employ the labour power of others to operate it. The experience of capitalism has been that petty commodity relations are unable to sustain the competition of capitalist relations and are thus eliminated, most of the actors becoming absorbed into the proletariat. They then offer only their labour power for sale, rather than the commodities they produce.

Social labour is created when workers are drawn together to produce as a unit, whereas individual labour occurs primarily in craft settings. Technology has the potential to socialize labour but control over that technology by capital distorts this potential by directing it towards particular ends — capital expansion through profitability — and not necessarily towards the benefit of workers or of society. Advanced capitalism socializes the means of production but not the relations of production. The means of production are organized for the purpose of capital expansion.

III. Transformations within Capitalist Relations

THERE HAS always been a formal subordination of labour in Canada's nickel mines but the real subordination of labour has involved a fairly lengthy process. This section will examine the way capital has penetrated the organization of work in nickel mines and undercut the relative autonomy of miners. These are processes still under way and by analyzing mines and surface operations at different stages of capitalization it is possible to understand the direction of the forces at work.

Until the late 1960s there were few changes in the labour process or the level of technology in Inco's mines. Miners worked in small crews performing an entire cycle of work: drilling, blasting, removing the ore, timbering, etc. There was a minimal amount of supervision: most miners saw a shift boss (or supervisor) only once a shift for a few minutes. Prior to large-scale mechanization the only significant technological innovations were the development of pneumatic drills to replace hand hammering or screw-drills and slushers to replace shovellers to move ore within the work place. Slushers reduced the amount of "bull-work" and were simple mechanical blade-like devices, operated by a member of the mining team, which scraped ore along the stope into an ore pass. Neither the pneumatic drills nor slushers seriously re-organized the social relations of production.

Since 1965 Inco has introduced over 500 pieces of trackless diesel equip-

ment into its Canadian mines.¹² There are now four basic types of mines: traditional hand mines, captured-equipment mines, ramp mines, and open-pit mines. Traditional hand mines continue with essentially the same level of technology and organization of work that has been in place since the turn of the century. Captured-equipment mines have introduced scooptrams (diesel-powered, front-end loaders) into traditional stopes (or work areas). The effect has been to enlarge these work areas somewhat, but the basic organization of production is retained. In captured stopes the scooptrams are disassembled on the surface and taken into the work areas where they are reassembled and maintained. They replace shushers in traditional mines and increase the miner's capacity to move ore. They are integrated into the traditional mining cycle and a scooptram operator (in captured-equipment stopes) is also responsible for other phases of mining together with the driller and stope leader. Ramp mines have revolutionized the organization of work underground. In them, there is a ramp built from the surface so heavy diesel equipment can be driven throughout the mine. Ramp mines are of two types: either blast-hole mines (like Creighton No. 3) where huge slices of ore are blasted at one time after months of long-hole drilling or enlarged stope mines (like Levack West) where different phases of the mining cycle are performed by specialized crews rotating through the giant stopes. In both types the number of work areas in a mine is dramatically reduced and the scale of the work place enlarged. Rather than being responsible for an entire cycle of work, each miner is essentially a machine operator and continuously performs one aspect of the work process (drilling, blasting, removing ore, bolting and screening, or sand-fill). The final type of mine, and the one which has induced much of the mechanization underground, is the open-pit mine. Here heavy diesel equipment is used in a surface mine and each person has a specialized task involving the operation of a particular piece of equipment. The major limitations of open-pit mining is the depth below surface it can practically go before true underground procedures must be used (only about 11 per cent of ore removed from nickel mines in Canada is from open pits).

A sense of the difference between types of mines is provided by a comparison of two mines standing side by side near Sudbury. Levack Mine was opened in 1900 and continues to use traditional mining methods. Employing 1000 workers, the mine's capacity is 5000 tons of ore a day. Levack West, a ramp mine, has been operating since 1974, and the 185 workers are able to produce 3800 tons per day. It has 47 pieces of diesel equipment for only 50 men per shift working underground, and 32 maintenance workers. Repairs are made to the diesel equipment in a huge maintenance bay built right into the rock underground. Each worker at Levack produces an average of 5 tons of ore per day; at Levack West the average is 21 tons per day.

¹² All information in this section on Inco's operations comes from the management of its surface operations and mines, union officials, mining workers, or trade journals. For a thorough overview, see Clement, *Hardrock Mining*.

In Inco's Sudbury mines, the cost of labour as a proportion of the overall production cost varies from less than 40 per cent in the most mechanized mines to over 70 per cent in the least mechanized. Increasing mechanization is being introduced into the mines, requiring less labour and less skilled miners to operate the equipment. The output of ore in the metal mining industry as a whole increased by 114 per cent between 1964 and 1973 and its value increased by 158 per cent, while the labour force grew by only 15 per cent. Obviously fewer workers using more equipment can produce more ore than they could using traditional methods.

The major types of trackless mining equipment introduced include diesel ore-moving machines such as scooptrams and load-haul-dumps (or ore carriers). A scooptram can move fifteen times the amount of ore per man shift as a slusher. Multi-boom jumbo drills, in which a driller stands on a platform and uses levers to control three drills are more common, together with another new form of drill, adopted from the petroleum industry, the in-the-hole drill which drills 6 1/2-inch holes two hundred feet in preparation for large-scale blast-hole mining (such as the Creighton No. 3 ramp mine). Compared to conventional drilling, in-the-hole drills reduce the drilling cost per ton from 55 to 24 cents. Raise borers have also been introduced. These machines make eight-foot diameter raises between levels underground; these raises are used for service passages, ore passes and ventilation. Traditionally this task has been performed by the most skilled miners, driving openings between the 200 foot levels. Raise borers drill 6 1/2-inch holes from one level until they break through below and then draw up huge bits 8 feet in diameter to carve out an opening. In 1968 there were only 10 raise borers in the world; by 1975 there were 200 (but only 25 in North America). In 1977 Inco had 14 of these machines and they had drilled 37 miles of raises in the Sudbury area alone. Each of the tasks now performed by these types of equipment was once done by skilled miners. Indeed, drilling, slushing, and driving raises were the three most skilled tasks underground. These same activities are now performed by machine operators who can be trained in a few weeks to perform tasks skilled miners took years to perfect.

The more equipment used underground, the more likely a miner will perform only one aspect of the mining cycle, the quicker he can be trained to perform his appointed task, and the greater the scale of the work area. From management's perspective, more mechanization means less reliance on the skills or individual initiative of the miner. Traditionally miners have trained one another in a *de facto* apprenticeship system. As a new miner was introduced into a mining crew he acquired the knowledge of the necessary skills from those he worked alongside. After a period of about two years as a driller working with a stope leader, the miner would move into another work area as a stope leader and train another driller. Both of these miners would be responsible for the entire cycle of work as outlined earlier. With the introduction of mechanized mining, management has appropriated the training process and designed it around each piece of equipment. This training will be discussed shortly.

Supervision in the mines is ambiguous in a number of respects. On the one hand, it has traditionally been very tough. Supervisors have exercised very arbitrary and at times ruthless power over workers in the past. On the other hand, miners have enjoyed a great deal of autonomy and seldom seen their supervisors. They organized and paced their own work. In addition to this basic ambiguity, the nature of supervision has been changing in response to mechanization and to larger work areas. The transformation of the mines from many small production stopes, numbering upwards of 100 in traditional mines, into a few large areas means that supervisors can keep a closer watch over workers and that workers themselves have less discretion in organizing or pacing their own work, since they are confined to the operation of one machine and one task.

Supervisors (or shift bosses as they are called by the miners) are themselves in an ambiguous position in the hierarchy of the mines. They are directly on the firing line between workers and management. In all of the shaft mines they are expected to cover a very large area with many distinct work places — all on foot; in ramp mines supervisors have access to vehicles that can move quickly from one area to another and the workers themselves are concentrated into a few work sites. In the shaft mines the supervisor is pressured by management to insure production but cannot directly oversee the men's work. Moreover, a greater differentiation takes place among the miners themselves as a result of centralized production. Not only do they become specialized in one task, but the stope leader who used to work alongside his driller in a partnership now becomes a stope boss who gives direction to several machine operators rather than performing the tasks himself.

In place of close supervision, mines have traditionally used a system of production "incentives" or a bonus system. During the formative period and through the years, the bonus became an institution integral to mining. It came to be called an "invisible supervisor" by the workers which induced miners to maximize production. This bonus is outside the wage structure negotiated by the union and is controlled by management. In theory the bonus is a simple incentive or inducement to reward miners for producing more ore or doing more development work quickly. In practice it is much more complex. It is a source of pride for many miners since it sets them apart from most workers in other industries and among miners it is a measure of skill and dedication to their trade; it is also a justification for taking the risk of working underground. To the unions it is a source of danger, luring miners to work unsafely and taking jobs away from other miners. To the companies it is a means of social control, the carrot that reduces the amount of supervision needed. In the minds of many, it is "what makes the miners go."

About one-half of all those working underground are on bonus. Underground the miner still commands a great deal of control and the company relies on the miner's ability, not just his hard work. Tradition in the mines has had it that anyone who can affect the rate of production is on bonus. This system is

still evident in all underground operations of Inco, but there are important variations as a result of mechanization. The most notable is Levack West, mentioned earlier as a ramp mine, where the entire mine is on a single contract rather than a bonus geared to a crew of miners in a single work area. Other mines have had the bonus system adjusted with mechanization as the rates of production needed to attain bonus have been revised upwards, mainly because the machine operator has less control over the rate of production and is deemed not to require as much inducement simply to keep his machine operating. When the machine sets the pace and supervision is direct, the bonus loses its original "invisible" control purpose.

Given the great distance between work crews and management, the bonus system is used to fill the gap. As tasks are subdivided and the co-ordinating role of management takes on greater importance as a result of mechanization, there is a trend away from this system. Supervisors have greater mobility and workers less control over their rate of production, leading some managers to conclude that the bonus is no longer necessary. The relationship between the bonus and the skill of the traditional miner is very close. There is not simply a correspondence between hard work and more money; technique has a lot to do with whether or not the miner will end up the month with no bonus or 500 dollars. This has at least been true in traditional mining. What is currently in dispute within Inco is whether or not the bonus is anachronistic in mechanized mines; that is, now that the real subordination of labour has been accomplished. Levack West may well be indicating the direction for the future: the open-pit mines, the most mechanized form of mining, have already abandoned the bonus.

The way technology has been introduced and the interests it serves have been controlled by capital, not by labour. Work has been re-organized for the miners, not by them. To be sure, it has reduced the amount of "bull-work" within the mines but at the expense of miners' jobs, not to create better ones. With the increase in mechanization it has been possible for management to penetrate — to a greater extent than in the past — the miner's control over the pace of his work and the skills he brings to bear. Management's strategy in introducing technology has been to decrease its reliance on the skills of the miners and to minimize the number and quality of workers needed, thus increasing their control over the work process and maximizing their profits from the benefits of technology. The miners have lost in many ways — in their ability to demand a bonus as a result of their control over the pace of work, in their knowledge of mining practices, in their numbers and, all too often, in their health and safety.¹² Technology is not neutral in the struggle between capital and labour because it has been employed from the outset to meet the needs of capital, not those of labour. It has been used to accomplish the real subordination of labour and to embellish the command of capital. Technologi-

¹² For an analysis of the relationship between health and safety and mechanization, see Clement, *Hardrock Mining*, ch. 7.

cal development does, however, offer the potential to humanize the labour process but only if it is adapted in a way most beneficial to those most directly affected — the miners.

Dramatic changes in the organization of work underground are matched by those on the surface in the mills, smelters, and refineries. Surface mining operations have traditionally combined "bull-work" and craft production. They have been labour-intensive even though highly mechanized, since workers perform a great deal of detail labour, much of it directly determining the quality of production. Workers usually control the machinery they work with rather than being controlled by it. With automation, the "bull-work" is eliminated but so is craft production. It is replaced by dial watching and patrol duty. The tasks are no longer those of controlling machinery; instead, workers monitor equipment and make repairs when necessary.

Automation has been introduced into the milling and refinery operations of Inco on a large scale but only certain aspects of the smelting operations have experienced automation.¹⁵ The Copper Cliff Mill, built in 1930, has only one-half the capacity of the Clarabelle Mill, built in 1971 for \$80 million, but employs 322 people compared to 235 for the new mill. Mills have always been quite capital intensive with the older mill having an operator to maintenance ratio of 1.3 to 1. The newer automated mill, however, actually has more maintenance workers than operators, with a ratio of 0.8 to 1.

Developments in refining are even more significant than in the mills. The Port Colborne Nickel Refinery, built in 1918 and using a labour-intensive electrolytic process, produced an average of 60,000 pounds of nickel a year per employee while the Copper Cliff Nickel Refinery, built in 1973 for \$140 million and using an automated high-pressure carbonyl process produces six times as much per employee or 360,000 pounds per year. With one-quarter the number of employees, the CCNR produces 50 per cent more nickel than the PCNR. The more labour intensive refinery has an operator to maintenance ratio of 1.8 to 1 compared to the automated plant where the ratio is 0.9 to 1. It should come as no surprise that in 1978 the PCNR was mothballed, aside from a few specialty items, and the CCNR has assumed virtually all the nickel refinery duties for the Ontario division.

¹⁵ In the Sudbury operations of Inco the milling operations on one side of the Copper Cliff Smelter and the refining operations on the other have been automated. Between these automated operations stands the labour-intensive smelter with 1650 hourly workers and 200 staff. It is without doubt destined for automation, likely requiring the construction of an entirely new building. It is interesting to note that this smelter is the base for the 1250-foot "super-stack" which daily disperses 3600 tons of sulphur dioxide into the atmosphere. A great public outcry over this pollution has occurred and the Ontario government has rescinded its order to cut emissions, effectively licensing the company to continue polluting at its present level until 1982. One must wonder whether Inco is fostering the outcry to strengthen its case with the state for subsidies to build a new plant, legitimized by sulphur dioxide reductions but having the effect of reducing the demand for labour.

Because it experienced mechanization much earlier than underground, surface supervision has always been much more direct. Workers are located in centralized operations. After automation, however, the nature of supervision changes again. With fewer workers, spread over a broader area, there is again a different form of supervision. Management does not need workers to perform constant operations; instead they need people to service equipment, to watch for problems, and to be available for maintenance. Contact is ensured by instrumentation to monitor the equipment and through radio contact with individual workers. Workers no longer have a direct hand in production and have virtually no control over the rate of production. The real subordination of labour reaches its ultimate; capital can directly control production by controlling instrumentation.

Mechanization underground and automation of surface operations have dramatically reduced Inco's labour requirements. Since 1972 the size of union locals at Inco have shrunk from 2800 to 750 at Local 6200 at Port Colborne; from 18,500 to 11,100 at Local 6500 in Sudbury; and from 2910 to 2250 at Local 6166 in Thompson. There has been an overall decline of hourly-paid workers by 42 per cent. Not only has there been a drastic reduction in the number of workers required, there has also been a decline in the quality of labour required by new labour processes. As the full implications of capitalization work themselves through the entire Canadian operations of Inco, it can be anticipated that even fewer and lower skilled workers will be required.

IV. Implications of Mechanization and Automation for Skills and Training

CHANGES in the use of equipment in mining have been accompanied by another form of technology — "people technology" as Inco managers refer to it — a form of training intended to meet the changed skill requirements brought about by greater capitalization and designed to give management even greater control over the labour process. The first major application of the MTS program (modular training) was at the highly-automated Copper Cliff Nickel Refinery in 1972. As a result of operators being required to do maintenance work (at operator's rates), there were over 1000 grievances filed in the first year. Arbitration ruled for an expansion of operators' tasks without an increase in pay. Modular training gives management the tools for pushing operators into more maintenance work, and for an expansion of tasks contained in each job. The tasks themselves are simplified and regularized with the minute division of labour and standardization inherent in modular training. Since March 1977 Inco has pursued a policy of extending modular training across its entire Ontario division, both underground and on the surface.

Modular training means that each operation is broken down into its parts and these parts become interchangeable and can be arranged in a variety of ways. At the same time performance rates and standards allow management to

control precisely the performance of workers. Every process and piece of equipment is documented in a systematic way and inventoried. Production is rationalized and each task subdivided into minute parts, whether it is an operating or maintenance task. A training manual is produced for each piece of equipment and is administered largely by self-learning.

The system is not yet entirely in place but according to the MTS report outlining the program for Inco, "many operators will learn (or be asked to learn) to do things that do not fall within their present duties."¹⁴ Maintenance workers will have more manuals than production workers but production workers will be trained on more than one manual. The unit is the equipment, not the person. In a trade there is a common core of skills. Principles and techniques are learned and these are then adapted to the situation. The training is broad. In modular training, however, the situation is determined by specific equipment; training is more immediate and "practical" (from the company's, not the worker's, perspective). The result for the worker is a limit on the marketability of their skills with modular training, hence reducing their mobility between companies and industries, unlike the wide applicability of skills learned by tradesmen.

MTS is a reaction to technology and is only applicable to highly-mechanized and automated tasks. It gives management leverage in utilizing and policing the time it takes workers to perform pre-determined and measured tasks. A person can be trained for a number of tasks and these tasks are then codes attached to him. Inco is moving ahead rapidly in the area of "people technology" just as it has in other forms of technology.

While management has been attempting to narrow the jobs its employees perform in the mining industry, workers have been attempting to broaden their skills. This is expressed in a program known as "miner-as-a-trade." The intent is to certify miners as in trades such as plumbers and mechanics that require "tickets" to practice. Miners have been certified in several European countries since 1951 but the first program in North America began in January 1975 in Manitoba. The apprenticeship is over a three-year period and requires eight weeks of school a year with the rest of the time spent working in specified areas. The mining companies were reluctant to become involved but the program was implemented by the New Democratic government because of union pressure. "Grandfather" tickets were issued to about 300 experienced miners with four or more years of mining in 1975 but the program was not made compulsory, denying the essential exclusive quality of traditional apprenticeship practices. Miners in Ontario have not yet been successful in having the program implemented.

"Miner-as-a-trade" in its present form is not going to revolutionize the industry. At present it is a mere drop in the bucket. In 1977 the first graduates completed the course; there were only six of them. There are only about 20

¹⁴ Management Training Systems, *Inco Consolidated Report*, Ontario Division (April 1976), 10.

people currently enrolled in the apprenticeship program in Inco's Thompson operation. As long as it is not a prerequisite to being a miner, there is little possibility that "miner-as-a-trade" will counteract the tendencies of fragmented labour inherent in mechanization and MTS as Inco is implementing them.

Contrary to the popular opinion that increased technology leads to greater skill requirements, the overall effects of automation and mechanization in combination with modular training have been the opposite. In part this is attributable to workers having less control over the functioning of machinery but it is also the result of simultaneous changes in the organization of work and the way workers are trained. In a classic study, James Bright of the Harvard School of Business identified this trend in 1958, arguing that "we tend to confuse the maintenance and design problems or exceptional operator jobs with the most common situation: namely that *growing automaticity tends to simplify operator duties*."¹⁵ Capitalization clearly results in de-skilling within mining if, following Bright, we define skill as a "blending of several things — manual dexterity, knowledge of the art, knowledge of the theory, and comprehension and decision-making ability based upon experience."¹⁶ While there has not been an increase in skill for production work, there has been in designing equipment and, in some cases, maintenance. In Canadian mining most of the equipment design takes place outside the country, thus reducing many of the potential benefits for the skilled component of the Canadian labour force in manufacturing.¹⁷

Moreover, maintenance work is itself being subjected to modular training practices which threaten the traditional tradesmen who have performed these activities. Elaborate educational systems and apprenticeships have traditionally been developed to transmit their skills, giving these workers considerable power, a power reflected not only in their higher wages but in their leadership position within the working class. Much of the tradesmen's leverage came from their freedom to change employers because of general skill shortages. Recent developments such as MTS, however, threaten to eliminate the company's need for their skills and hence their power. Individuals no longer have traditional training and become tied instead to specific equipment and specific companies. Tradesmen become more expendable as companies develop means to transmit rapidly aspects of their trades to unskilled workers. Increased capitalization will certainly demand a great deal of maintenance work, but these tasks are being performed by workers trained to maintain specific equipment rather than by tradesmen. This will probably lead to a fall in the value of

¹⁵ James Bright, *Automation and Management* (Boston 1958), 183, emphasis in original.

¹⁶ *Ibid.*, 187.

¹⁷ See John N.H. Britton and James M. Gilmour, *The Weakest Link: A Technological Perspective on Canadian Industrial Underdevelopment*. Science Council of Canada Background Study, No. 43 (Ottawa 1978), 94.

the labour power of maintenance workers and a diminishing of apprenticeships.

For the most part, management has been successful in implementing changes in the techniques of production and training. They serve the twin goals of increasing the ability of capital to accumulate and of management to control the workers. These strategies have been costly; tremendous amounts of money have been invested in capital equipment and training programs. But in the long term management feels these investments will increase their power at the expense of workers. There is every reason to believe they are right, particularly since unions, at least at Inco, have been unsuccessful in resisting these developments.

V. Conclusion

TWO ASPECTS of class transformation have briefly been explored in the case of Canadian mining. The first was the transformation from petty commodity to capitalist production. It was argued that the autonomous organization of work, craft skills, and bonus system meant that all the characteristics of this form were not completely destroyed with the formal subordination of labour. These remnants are, however, disappearing with the real subordination of labour. The most obvious change in the property relations of mining occurred with the destruction of the petty commodity form, but there have also been significant changes within capitalism itself. As a result of mechanization, the autonomous organization of work and the bonus system are threatened.

The quality of labour required to operate and maintain a traditional electrolytic refinery differs from that required for an automated carbonyl process refinery. This is not a mere mechanical relationship. On the one side capitalists seek to minimize their variable costs in the form of labour and maximize their fixed costs in capital, thus reducing the amount of labour required. On the other side labour struggles against its own elimination and against changes in the demands made by capitalists. The forces and relations of production are dynamically related, each having implications for the other. The fundamental relation is, however, a social one: capital controls labour in order to maximize profitability and uses the technical division of labour as a means to accomplish this end.

As a consequence of capitalization, management strategies toward workers have changed. Underground there has been a strong tendency to move away from the traditional "responsible autonomy" of mining crews towards greater direct control. On the surface direct control has always been more prevalent but with automation, new strategies have been devised. Automated plants like Clarabelle Mill and the Copper Cliff Nickel Refinery have different labour requirements than do labour-intensive operations. Workers are required more for patrol and maintenance than for detailed labour. As a result, there is at least the appearance and ideology of a "responsible autonomy" strategy on the part of management. In fact, workers and first-line supervisors find that what they

are responsible for is accountability, not decision-making. They have virtually no control over the actual work process, this having been programmed into the equipment.

The effect of capitalization is to decrease dramatically the need for both skilled and unskilled labour. They are replaced by "semi-skilled" labour. Both heavy manual labour and craft skill give way to machine tenders and those patrolling equipment programmed to perform pre-designed tasks. This is not an automatic process — labour resists management strategies because many jobs are lost and the strongest faction of the working class, the tradesmen, are directly threatened. The consequence of the overall trend is towards a homogenization of the working class in mining. The net effect may well be a stronger, more unified class in a political and ideological sense since the impact of these processes tends to decrease traditional divisions within the working class between operations and maintenance, labourers and craft workers, and even surface and underground workers.

Class struggle focuses on control over the production process and the distribution of the expanding surplus which technology makes possible. Having broken the power of the craftsmen and eliminated most labourers, capital can afford to increase the wages of the remaining workers and still appropriate the lion's share of the surplus. Struggles for control rather than those for wages are much more threatening to capital. The forces outlined may well open the possibility for broad-based action by workers to appropriate the means of production.

It is not the introduction of technology *per se* or the technical division of labour that have caused the negative effects of technology, but the social relations of production and the way technology is used as a strategy by management to minimize control by workers. As Marx observed for the initial industrial revolution, "It took both time and experience before the workpeople learned to distinguish between machinery and its employment by capital, and to direct their attacks, not against the material instruments of production, but against the mode in which they are used."¹⁸ It is no longer possible (or even desirable) to return to petty commodity production in mining. The forces of production have become "socialized" by giant multinational corporations. The only progressive direction would be to socialize the relations of production; that is, create a system of property relations whereby the means of production become the common property of those working them and providing rights and claims to the consumers of the products. It may first be necessary to nationalize the mines and processing facilities by turning them into state property, but this would have little bearing on the relations of production. If there are to be equitable and just relations of production and a guarantee of the safest working conditions, it will be necessary for those most directly affected to control the conditions and organization of their work.

¹⁸ Marx, *Capital*, I, 429.