**Historical Papers**
**Communications historiques**

# Canadian Railways as Manufacturers, 1850-1880

Paul Craven et Tom Traves

Volume 18, numéro 1, 1983

Vancouver 1983

URI : https://id.erudit.org/iderudit/030909ar
DOI : https://doi.org/10.7202/030909ar

Aller au sommaire du numéro

Éditeur(s)

The Canadian Historical Association/La Société historique du Canada

ISSN

0068-8878 (imprimé)
1712-9109 (numérique)

Découvrir la revue

Citer cet article

Craven, P. & Traves, T. (1983). Canadian Railways as Manufacturers, 1850-1880. *Historical Papers / Communications historiques*, *18*(1), 254–281. https://doi.org/10.7202/030909ar

Résumé de l'article

Depuis longtemps, les chemins de fer ont constitué un des sujets préférés des praticiens de l'histoire économique. Toutefois, seuls les aspects de leur construction et de leur financement ont retenu l'attention des chercheurs et, à date, les compagnies de chemins de fer n'ont été considérées qu'en tant que compagnies de transport. Cette optique, pourtant, fausse la réalité puisque les principales compagnies de chemins de fer au Canada ont été considérables et que leurs activités ont couvert un vaste éventail d'entreprises économiques. De fait, dans la deuxième moitié du XIXe siècle, elles comptaient parmi les plus importantes firmes manufacturières du pays.

C'est ce que l'on démontre ici par le biais d'une étude de l'un des aspects de leurs activités manufacturières, soit celui qui concerne les locomotives et les wagons. Il appert, en effet, que non seulement les grandes compagnies ont construit leurs wagons et leurs locomotives mais qu'elles ont également mis sur pied des ateliers pour les réparer et des usines pour fabriquer l'outillage et les pièces nécessaires à leur entretien, leur réparation et leur recyclage. Qui plus est, ces ateliers et usines ont été parmi les mieux administrés et les plus avancés technologiquement au pays. Il est évident donc, selon les auteurs, que la vision traditionnelle de la place des chemins de fer dans le processus d'industrialisation au Canada doit être révisée à la lumière d'études portant sur les activités manufacturières qu'ils ont engendrées. Peut-être, d'ailleurs, ces études mèneront-elles les chercheurs à s'interroger sur les raisons pour lesquelles les autres manufactures canadiennes ont accusé tant de retard par rapport aux progrès accomplis à l'époque par les grandes compagnies de chemins de fer.

# Canadian Railways as Manufacturers, 1850-1880*

## PAUL CRAVEN AND TOM TRAVES

Most accounts of Canadian industrialization in the mid-nineteenth century attribute a dual role to the railways. First, by breaking down the old "tariff of bad roads" that protected small local markets for artisanal producers, they laid the groundwork for the concentration of industrial production in a handful of metropolitan centres. Second, it is often recognized that the railway companies were themselves important markets for a wide range of commodities, and so helped to create the opportunity structure for new investment in manufacturing. While the significance of the railways in the development of the market is indisputable, however, it is less frequently recognized that the railways were important industrial *producers* as well. Indeed the well-worn argument that railways represented commercial, as *opposed* to industrial, capital becomes quaintly irrelevant once it is realized that these companies owned and operated some of the largest and most sophisticated manufacturing plants in the Canadian economy from the early 1850s on.[1]

Railways were not just simple transportation companies. To understand their operations and management from their inception in the 1850s it is necessary first to appreciate the range of functions they performed in the daily course of business. In some respects they operated almost like states unto themselves; their company rules had the force of law, they employed their own police, and their executives, as the Grand Trunk's goods manager put it, were "as important as generals in an army or Ministers of State".[2] By 1860 the typical large railway, like the Grand Trunk or the Great Western, had the capacity to rebuild its line and repair its tracks, to manufacture its own cars and locomotives and even a good part of the machinery and equipment used in these manufacturing processes, to communicate telegraphically, to store and forward freight, to operate grain elevators and steamships, and to maintain large depots and complex administrative offices, all in support of its basic service as a common carrier. In short, the railways were Canada's first large-scale integrated industrial corporations.

* Research for this paper, and for the larger Canadian Railways Industrial Relations History Project of which it forms a part, has had the generous support of the Social Sciences and Humanities Research Council of Canada. We gratefully acknowledge the research assistance of David Sobel and Rose Hutchens

1. In December 1862, the Great Western's Inside Locomotive Department (*i.e.* shops as distinct from running trades) employed 255 men at Hamilton, and the Car Department 265; see Hamilton Public Library, GWR Mechanical Dept. Paysheets. In early 1860 the company held a dinner for six hundred men to celebrate the completion of the first locomotive built entirely in its shops; see Hamilton *Spectator,* 10 February 1860. The Grand Trunk published a breakdown of employment and wages in its locomotive department in its *Report* for the half-year ending 31 June 1859, showing 684 men employed in its locomotive shops alone.
2. Myles Pennington, *Railways and Other Ways* (Toronto, 1894), p. 119.

This essay focuses on one aspect of integrated railway operations, the manufacturing activities of the railways' locomotive and car departments. By describing the nature and scope of these activities, and some features of the plant, organization and technology that sustained them, it is intended to contribute towards a reassessment of the railways' place in the history of Canadian industrialization.

## THE SCOPE OF MANUFACTURING

The Grand Trunk and the Great Western, in common with some smaller roads, built extensive car shops as part of their original construction programme in the early 1850s, but at the outset they leased these structures to private contractors who equipped them to supply large orders for cars. Although they had to cope with eager competition from British and American car builders, and had to import such crucial parts as wheels and axles, independent Canadian car manufacturers were able to realize their considerable transportation cost advantage to dominate the local market. Dissatisfaction with the quality of the product, and even more pressing difficulties with financing large purchases, soon brought the railway companies to the view that it would be both cheaper and more efficient to build some of their cars themselves. In March 1855, the cash-poor Great Western attempted to cover its debts by foisting GWR bonds on its principal suppliers; shortly thereafter the company cancelled outstanding contracts and began building its own cars. "It is believed that a considerable saving, both in first cost and repairs, may be effected," its president explained, "by the company building cars in their own workshops, besides insuring the use of none but the best materials, which is the greatest safeguard against accidents. . . ."[3]

The Grand Trunk entered the car business for exactly the same reasons. After its major supplier refused to do any more work on credit, the GTR board accepted its chief engineer's proposal to operate the company's Point St. Charles workshops on its own account. By July 1857 the GTR car works were supplying half the road's requirements, and the board was so impressed with this success that it decided to construct an iron foundry, rolling mills and machinery to produce its own rails as well.[4]

The more complicated task of building locomotives was not undertaken until a little later. Independent Canadian suppliers certainly were active in this market as in cars, but at first the bulk of the orders went to large producers in Britain and the United States. While there was a certain bias in favour of the British engines, not only because they were heavier and more substantially built, but also because of the preponderance

3. Public Archives of Canada (hereafter PAC), RG 30, Canadian National Railways Papers (henceforth *CNR*), vol. 1, 24 August 1855, Report of G.L. Reid, Chief Engineer, to the Shareholders; *ibid.*, 4 June 1853; *CNR* 1000, 11 December 1856; PAC, John Young Papers, 20 April 1852; *CNR* 2, 2 September 1853; 2 February 1855; 2 March 1855; 30 March 1855; Hamilton *Spectator*, 15 September 1855.
4. *CNR* 1000, 11 December 1856; Montreal *Pilot*, 1 August 1857.

of British capital invested in the Canadian railways, American locomotive builders were able to capture a substantial share of the market because of shipping costs and the readier availability of spare parts. Still, there were complaints about quality from both sources and some British engines proved to be unsuitable for the sharp curves and rough roadbeds characteristic of the Canadian lines. Gradually such Canadian suppliers as Kinmond Brothers (Montreal), Daniel C. Gunn's works (Hamilton), William Hamilton's St. Lawrence Foundry (Toronto), Good's Foundry (Toronto), and the Canadian Locomotive Works (Kingston) began production. By 1857 the Grand Trunk was placing orders for eight engines from British manufacturers, seven from Americans, and thirty-two from Canadian builders.[5]

Both the Grand Trunk and the Great Western began to consider building locomotives in their own shops, not only for the familiar reason, that it would ''doubtless effect a considerable saving in expense'', but also because it could furnish slack-time employment for skilled shopworkers in whose recruitment and retention the railways had a large investment. Grand Trunk shops turned out the *Trevithick* in May 1859, and the Great Western's *George Stephenson* was put to work a few months later.[6]

Between January 1864 and December 1873, the Grand Trunk shops built forty-nine new locomotives, or five per year on average. In the same period, they produced 1224 new freight cars (122 per year) and rebuilt, thoroughly renovated or converted substantial proportions of their existing stock. Over the ten years, the Grand Trunk built 172 new passenger cars (seventeen per year), and converted, thoroughly renovated or rebuilt 573 more (fifty-seven per year). In 1880, when the pattern of shopwork characteristic of the early 1870s had been reestablished after the disruptions

---

5. Toronto *Globe*, 28 April 1853; W.M. Spriggs, ''Great Western Railway of Canada'', *Bulletin of the Railway and Locomotive Historical Society*, 51; John Loye, ''Locomotives of the Grand Trunk Railway'', *ibid.*, p. 25. The rivalry of British and American locomotive builders was regularly vented in industry periodicals on both sides of the Atlantic. For a contemporary comparison of costs and labour content see *American Railway Review*, 5 (1862), p. 230, copying *The Engineer* (London), 22 November 1861. Independent Canadian producers were extremely vulnerable to recession, and only the Kingston works survived as a locomotive builder to the end of the century. See W.G. Richardson, ''The Canadian Locomotive Company in the Nineteenth Century'', paper presented to Canadian Historical Association, Annual Meeting, Kingston, 1973. Hamilton *Spectator*, 9 August 1856, 28 February 1857, 3 September 1857 and 4 January 1858; Toronto *Globe*, 28 April 1853; Toronto *Leader*, 6 February and 24 March 1854; *CNR* 2, #1148, 16 January 1857; *Railways and Other Ways*, p. 86; *Dictionary of Canadian Biography*, X (Toronto, 1972), p. 330f. [William Hamilton]; Bryan D. Palmer, *A Culture in Conflict* (Montreal, 1979), p. 14; Montreal *Pilot*, 1 August 1857; Montreal *Gazette*, 30 April 1852; *CNR* 2, #709, 8 June 1855. Hamilton's abandoned the locomotive and general machine business to specialize in producing railway cars and railway iron; see Toronto *Mail*, 18 April 1872.
6. Hamilton *Spectator*, 25 January 1861. See Paul Craven and Tom Traves, ''Dimensions of Paternalism: Discipline and Culture in Canadian Railway Operations in the 1850s'', in C. Heron and R. Storey, eds., *On the Job* (forthcoming). Hamilton *Spectator*, 10 February 1860; Hamilton *Times*, 12 May 1859; Toronto *Globe*, 17 May 1859.

occasioned by the change of gauge, the Grand Trunk built eighteen locomotives, thirty-one new passenger cars and 550 new freight cars, as well as converting, rebuilding or thoroughly renovating fifty-two passenger and 1414 freight cars. The shops also manufactured or remanufactured substantial quantities of parts to be used in repair; in the early 1870s, for example, the GTR car shops were turning out approximately six hundred new and renewed trucks per year, as well as between a thousand and fifteen hundred additional new and renewed axles.[7]

Similarly, the Great Western's locomotive shop manufactured or rebuilt sixty-eight engines — four a year on average — between 1860 and 1876. Like the Grand Trunk's it also produced parts and components used in locomotive manufacture and repair. For example, in the year ending 31 January 1871 the GWR turned out five crank axles (four steel, one iron), eleven straight engine axles, eleven truck axles, twenty-two tender axles, sixty-four axle boxes, twenty-six pistons, eight eccentric pulleys, four eccentric straps, twenty-one crank pins, three cross heads, nine driving wheels (eight cast iron, one unspecified), 389 chilled wheels, forty-five engine springs, sixty tender springs, eleven engine bells, 118 steel tyres, two tender trucks, one connecting rod, four valve spindles, two tender frames, and two flue-sheets (one copper, one steel), as well as completing three new boilers to be used in rebuilding locomotives and beginning work on three others. The Great Western's car shops were equally busy with new construction and rebuilding.[8]

Figures like these seriously underestimate the extent of manufacturing activity in the car and locomotive departments of the major railways, however. First, the published reports provide little or no systematic information about the production of all sorts of parts and components, although we know from various sources that a wide range of such things, such as iron bridge castings, locomotive boilers, springs, cast iron and wrought iron wheels, and lamps of various descriptions, were made in quantity by the shops, as well as such items of operating equipment as semaphore signals.[9]

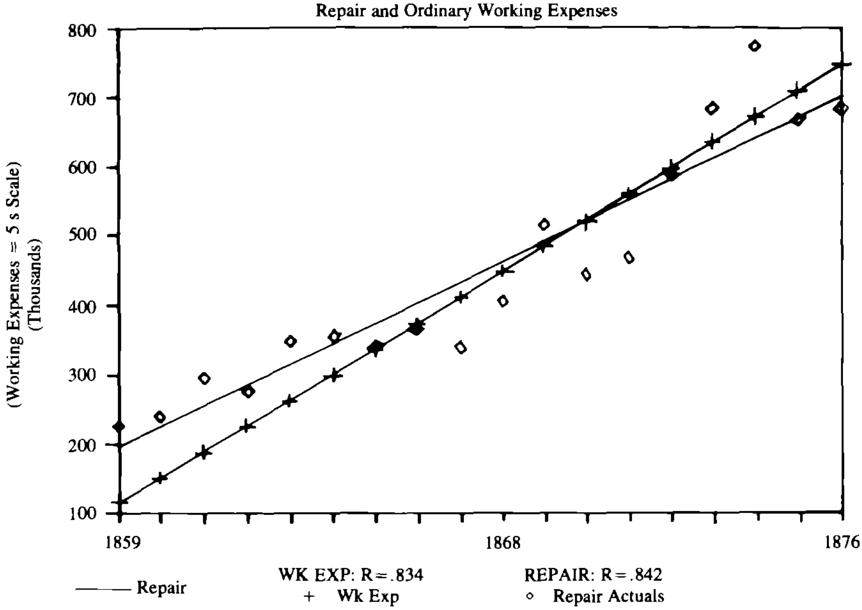
Second, there is a dearth of systematic quantitative information about the manufacture of tools and machinery for use by the railway shops themselves. Again,

---

7. The data in this paragraph are calculated from mechanical (or locomotive) superintendents' reports and associated tables published in the Grand Trunk's half-yearly *Reports* (varying titles) for the appropriate dates. We have so far been unable to compile a wholly unbroken run of these reports from mid-1854 (when the first one appeared) to mid-1863. The December 1873 cut-off date is used here because the Grand Trunk's change of gauge substantially altered the pattern of shopwork in the years immediately following.
8. For details on locomotive components and construction see, for example, Matthias N. Forney, *Catechism of the Locomotive* (New York, 1883). The figures in this paragraph are calculated from the Great Western's *Reports* for the appropriate dates.
9. *CNR* 7, #1597, 27 August 1861; #1643, 15 January 1862; GTR *Report*, half-year ending 30 June 1869, p. 11; GWR *Report*, half-year ending 31 January 1861, p. 27; Hamilton *Spectator*, 9 August 1860; *CNR* 1042, 28 November 1879; *CNR* 6, #1649, 26 February 1864.

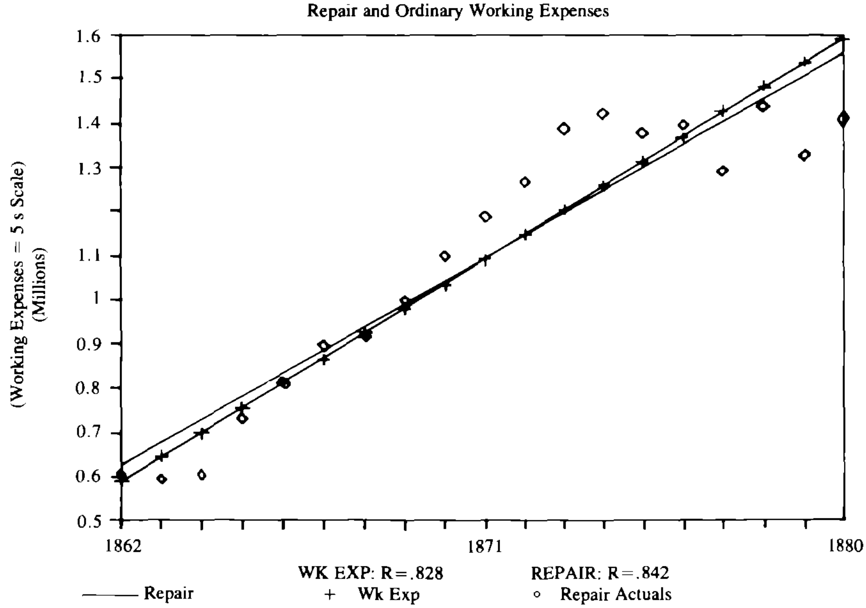
## GREAT WESTERN RWY: TRENDS 1859–76

Repair and Ordinary Working Expenses




## GRAND TRUNK RWY: TRENDS 1862–80

Repair and Ordinary Working Expenses



we know that they produced a wide range of such equipment, from the machinery for turntables and grain elevators to such sophisticated machine tools as the "powerful drilling machine with six drills . . . for drilling the iron skeletons for our new trucks, and a similar machine with fine drills . . . for boring the wood-work of the same trucks", which the Grand Trunk built in 1869; "by the use of these and other labour-saving machinery we are enabled to build trucks at a much lower cost than in former years."[10]

Third, and perhaps most important, it is necessary to consider the extent to which shopwork characterized as "repair" really amounted to manufacturing activity. On the Great Western, it was said that "a first-class car . . . only lasts nine years, or, in other words, at the close of a nine years' servitude, the repairs will have been so numerous and extensive that not one atom of the original car remains in use." The Grand Trunk's mechanical superintendent said that much of the "general repairs" consisted in "actual rebuilding of cars", and warned not to take the construction figures as a "measure of the actual work done towards maintenance inasmuch as a very large number of cars receive from one half to four fifths of new material into their construction, none of which are reckoned as new cars".[11]

The work of the railways' car and locomotive shops might be classified under five headings: maintenance, repair, renewal, replacement, and capital construction. Replacement and capital construction involved essentially the same sorts of activity — building cars or locomotives "from scratch" — but for the most part they were reported differently in the railways' accounts.[12] Great Western (subsequently Grand Trunk) locomotive superintendent Richard Eaton defined renewals as "that class of work which adds new and additional life to the Engine, beyond its average term of fifteen years. Consequently new fire boxes, Tubes, Tyres or Wheels, supplied to Engines under the ordinary heavy repairs cannot be considered as renewals, as these, and other articles, are necessary to the life of fifteen years alone."[13] At the other extreme maintenance might be distinguished from light repairs by limiting it to routine cleaning, lubricating, and so forth.

## EXPENDITURE ON MANUFACTURING

In attempting to draw the line between manufacturing and other types of activity in the locomotive and car departments, there is a risk of making the distinctions unnecessarily fine. In contemporary discourse, we are prepared to consider simple

10. *CNR* 7, #1380, 20 May 1859; *ibid.*, #*s*1651-2, 11 March 1862; GTR *Report*, half-year ending 30 June 1869, p. 11.
11. Hamilton *Spectator*, 4 March 1857; GTR *Report* for half-year to 30 June 1864; *ibid.*, half-year to 30 June 1865. "Maintenance" here meant keeping the car stock up to numerical strength.
12. It was not until well into the 1860s that the larger railway companies worked out even a moderately consistent accounting response to the problem of depreciation; previously new equipment had frequently been charged to revenue account, and renewals to capital.
13. *CNR*, #1643, 15 January 1862.

parts-assembly operations to be manufacturing plants, and workers who sweep the floors and keep the tools to be production workers. It is difficult to see why any greater terminological precision should be required of nineteenth-century industry. The most sensible demarcation between manufacturing and nonmanufacturing activity in the locomotive and car departments is that between light repairs and maintenance. In practice, the distinction may be drawn (where the data permit) between ''running repairs'' or ''front-shop'' work, and ''back-shop'' work; in other words, between repair work done in the main car and locomotive shops, and repairs done in the engine houses and car sheds, or at minor running shops along the line. This is more or less the distinction embodied in the modern Standard Industrial Classification, which views in-shop repair work as manufacturing activity, and maintenance and running repairs as a service incidental to transportation. It is a reasonable compromise between theoretical rigour and practical applicability.[14]

Unfortunately, it is not possible on the basis of the available data to separate maintenance from other mechanical department activities, or running repairs from work done in-shop, on any really satisfactory basis for the period of this paper. Mechanical superintendents on the larger railways reported in some detail the volume of repair and renewal activity of various sorts, but these reports almost always excluded running repairs; thus Eaton reported on ''heavy'', ''medium'', and ''light'' engine repairs on the Grand Trunk, but noted that his figures did not include ''those repairs done in Steam sheds, or which only occupied a week or so in the repair shops''. His successor Herbert Wallis used a similar three-fold distinction, ''without taking into account the light or running repairs done at our *ten* outside Loco. Stations'', but included engines which had been three days or more in the shops under ''light repairs''. In reporting on repairs in the car department, he listed ''the more prominent items, leaving out of the record all Cars less than twenty-four hours under repair, and upon which a large staff are continually employed''.[15]

Two data series are available. One, to be found for the most part in the mechanical superintendents' reports on the larger railways, provides information on the range of shopwork and some quantifiable material on the volume of certain activities. The other consists of mechanical department expenditures summarized in the railway company accounts. The first series does not report systematically on out-of-shop and maintenance activity, while the second does not systematically distinguish between manufacturing and maintenance expenditures. The first type of data has been drawn on extensively in the first part of this essay. Here we turn to the financial series in an attempt to estimate the value of manufacturing activity in the railway mechanical departments.

14. Canada, Dominion Bureau of Statistics/Statistics Canada, *Standard Industrial Classification Manual* (Ottawa, 1948); *ibid* (Ottawa 1960); *ibid* (Ottawa, 1970); *ibid* (Ottawa, 1980). The latest revision is somewhat opaque in its criteria as compared to earlier versions.
15. Canadian National Railways Library, Richard Eaton, ms. half-yearly report of mechanical superintendent, GTR, for 31 December 1864; GTR *Report* for half-year ending 30 June 1878, p. 12; *ibid,* half-year ending 31 December 1879, p. 14; *ibid,* half-year ending 30 June 1878, p. 13.

Manufacturing activity in locomotive and car departments appears in both the capital and revenue accounts. Railway accounting practices were inconsistent in this period (especially in the earlier years), and one suspects that the assignment of an item to one or the other frequently depended on a political assessment of the shareholders' collective frame of mind rather than on any theory of industrial finance. New equipment built in the railway shops was sometimes assigned to capital and sometimes to revenue. Renewals and replacements were frequently charged to revenue simply because they brought the department's stock up to numerical strength, without any regard to the substantial improvement of the stock that they often represented. Unfortunately, the schedules of additions to capital account reported by the major railways are very difficult to work with. The information they provide is incomplete, and items are sometimes accounted for years after the expenditure has been made. About all that can be said of the capital account data is that the railway shops evidently produced a substantial annual volume of rolling stock over and above the expenditure shown in the revenue accounts.

The locomotive and car repair schedules in the revenue accounts supply a more satisfactory basis for estimating the value of manufacturing activity in the railway mechanical departments. Tables I and II summarize the locomotive and car repair schedules in these accounts for the Great Western (1858-76) and Grand Trunk (1861-80) respectively, while Figures I and II illustrate the growth trends. "Repair" in these schedules included new construction (on account of renewals or otherwise charged to revenue), rebuilding, conversion, and so forth — in short, the whole range of shopwork as discussed above. Our tabulations incorporate a number of adjustments for the inclusion of nonmanufacturing items and the exclusion of costs that may properly be attributed to manufacturing.

The total expenditure on locomotive and car repair shown in the tables should be taken as a minimum estimate of expenditures on manufacturing in the mechanical departments. It ignores entirely expenditure on capital account (which fluctuated widely from year to year and which, as discussed above, cannot be systematically quantified), and it does not take into account other costs of manufacturing which are charged elsewhere. Among the latter are manufacturing-related expenditure in the storekeepers' departments, and possibly some transportation expenditures as well. In sum, it is a conservative claim that the Great Western mechanical departments expended a quarter of a million dollars on manufacturing activity in 1859, and over three-quarters of a million in 1874; or that the Grand Trunk spent over $600,000 a year on mechanical department manufacturing in the early 1860s and about $1.5 million annually in the later 1870s. Manufacturing expenditure on revenue account grew steadily over the period as a proportion (approximately 20 per cent) of total ordinary working expenses.[16]

16. Car and locomotive renewal funds have been included in the tables whether or not they were reported separately in the original accounts. On both railways, mechanical department expenditures increased rapidly during the change of gauge due to new construction and (especially) the herculean task of conversions. In the years immediately following the change, repair and renewal expenditures dropped sharply since so much of the stock was new or had recently undergone extensive rebuilding. These factors account for the larger departures from trend in the Figures.

**Table I: Great Western Railway Mechanical Expenditures on Revenue Account 1858-1876**

| For Year Ending 31 July — | 1859 | 1860 | 1861 | 1862 | 1863 | 1864 | 1865 | 1866 | 1867 |
|---|---|---|---|---|---|---|---|---|---|
| **REVENUE ACCT ($)** | | | | | | | | | |
| **Ordinary Working Expenses** | **1056514** | **1093184** | **1150179** | **1185289** | **1289903** | **1296856** | **1276358** | **1407214** | **1670578** |
| Locomotive Repair: | | | | | | | | | |
| Materials, fuel & light | 63324 | 59491 | 80305 | 69437 | 77361 | 77351 | 73418 | 77648 | 75410 |
| Wages | 100497 | 106150 | 99041 | 98407 | 102688 | 101051 | 96301 | 93765 | 91918 |
| Car Repair: | | | | | | | | | |
| Materials | 24955 | 25215 | 55563 | 57998 | 91080 | 105135 | 90019 | 103756 | 102771 |
| Wages and salaries | 42451 | 47780 | 61844 | 48426 | 77320 | 73255 | 83021 | 92831 | 71568 |
| **TOTAL Loco. & Car Repair** | **231227** | **238636** | **296753** | **274268** | **348449** | **356793** | **342759** | **368000** | **341666** |
| **Loco & Car Repair as % of Working Expenses** | **21.89** | **21.83** | **25.80** | **23.14** | **27.01** | **27.51** | **26.85** | **26.15** | **20.45** |

| | 1868 | 1869 | 1870 | 1871 | 1872 | 1873 | 1874 | 1875 | 1876 |
|---|---|---|---|---|---|---|---|---|---|
| **REVENUE ACCT ($)** | | | | | | | | | |
| **Ordinary Working Expenses** | **1928958** | **2132458** | **2389675** | **2591103** | **3116615** | **3864456** | **4161520** | **3626863** | **3440306** |
| Locomotive Repair: | | | | | | | | | |
| Materials, fuel & light | 81114 | 83235 | 71599 | 57584 | 113910 | 136078 | 178196 | 146525 | 139111 |
| Wages | 96348 | 107546 | 84963 | 98744 | 98410 | 97593 | 100868 | 91526 | 99193 |
| Car Repair: | | | | | | | | | |
| Materials | 131396 | 158090 | 168116 | 193830 | 238691 | 250913 | 293055 | 260581 | 322161 |
| Wages and salaries | 100243 | 167980 | 120675 | 119753 | 140364 | 200451 | 202445 | 171054 | 123399 |
| **TOTAL Loco. & Car Repair** | **409100** | **516851** | **445353** | **469910** | **591375** | **685034** | **774564** | **669686** | **683864** |
| **Loco & Car Repair as % of Working Expenses** | **21.21** | **24.24** | **18.64** | **18.14** | **18.97** | **17.73** | **18.61** | **18.46** | **19.88** |

## Table II: Grand Trunk Railway Mechanical Expenditures on Revenue Account 1861-1880

| For Year Ending 30 June — | 1862 | 1863 | 1864 | 1865 | 1866 | 1867 | 1868 | 1869 | 1870 | 1871 |
|---|---|---|---|---|---|---|---|---|---|---|
| **REVENUE ACCT ($)** | | | | | | | | | | |
| **Ordinary Working Expenses** | **3216588** | **3048838** | **2950474** | **3830136** | **3995466** | **4217006** | **4368914** | **4527229** | **4887459** | **5311995** |
| Locomotive Dept: | | | | | | | | | | |
| Materials for repair | 143824 | 103893 | 102804 | 129216 | 152364 | 175409 | 164223 | 172570 | 228051 | 235428 |
| Wages for repair | 124174 | 135461 | 146680 | 143178 | 168034 | 196168 | 197975 | 210555 | 208419 | 210160 |
| Repairs to tools &c | 23709 | 32640 | 37366 | 52821 | 63889 | 77639 | 74613 | 96416 | 81158 | 85086 |
| Workshop fuel | 18484 | 11608 | 9350 | 11350 | 13216 | 14999 | 19896 | 17909 | 17138 | 20041 |
| Car Dept: | | | | | | | | | | |
| Materials for repair | 148224 | 175113 | 160665 | 220460 | 238833 | 240378 | 258453 | 266191 | 315548 | 351471 |
| Wages for repair | 138689 | 136579 | 148101 | 178113 | 177629 | 191016 | 202248 | 233758 | 249138 | 284508 |
| Repairs to tools &c | 8523 | | | | | | | | | |
| **TOTAL Loco. & Car Repair** | **605625** | **595293** | **604966** | **735138** | **813964** | **895608** | **917406** | **997399** | **1099450** | **1186694** |
| **Loco & Car Repair as % of Working Expenses** | **18.83** | **19.53** | **20.50** | **19.19** | **20.37** | **21.24** | **21.00** | **22.03** | **22.50** | **22.34** |

| | 1872 | 1873 | 1874 | 1875 | 1876 | 1877 | 1878 | 1879 | 1880 | 1st Half 1881 |
|---|---|---|---|---|---|---|---|---|---|---|
| **REVENUE ACCT ($)** | | | | | | | | | | |
| **Ordinary Working Expenses** | **5769919** | **6429224** | **7399655** | **7959598** | **7761781** | **6905539** | **7182064** | **6715908** | **6940761** | **3919473** |
| Locomotive Dept: | | | | | | | | | | |
| Materials for repair | 209776 | 234646 | 223214 | 203710 | 219670 | 150559 | 213649 | 181678 | 237820 | 135126 |
| Wages for repair | 243216 | 263539 | 219490 | 213401 | 241849 | 259164 | 308569 | 303564 | 323949 | 172079 |
| Repairs to tools &c | 91586 | 101329 | 111358 | 110429 | 115588 | 111135 | 118350 | 106435 | 95953 | 55375 |
| Workshop fuel | 24160 | 29739 | 32116 | 36630 | 37549 | 32454 | 29721 | 26346 | 25046 | 12445 |
| Car Dept: | | | | | | | | | | |
| Materials for repair | 386651 | 425073 | 469196 | 438340 | 432614 | 384809 | 389330 | 345169 | 357795 | 184970 |
| Wages for repair | 311923 | 332654 | 366460 | 378264 | 348530 | 354279 | 381120 | 365284 | 367876 | 200119 |
| Repairs to tools &c | | | | | | | | | | |
| **TOTAL Loco. & Car Repair** | **1267313** | **1386979** | **1421834** | **1380774** | **1395799** | **1292399** | **1440739** | **1328475** | **1408439** | **760114** |
| **Loco & Car Repair as % of Working Expenses** | **21.96** | **21.57** | **19.21** | **17.35** | **17.98** | **18.72** | **20.06** | **19.78** | **20.29** | **19.39** |

It should be noted that these expenditure figures are not equivalent to census value-added statistics, in that they include no profit component and, so far as we can ascertain, no market price adjustment for materials and components manufactured by the railway companies themselves. But even on a straight comparison of mechanical department expenditures to census value-added figures for other manufacturers, it appears plain that the railways were among the largest manufacturing firms in Canada in the period, and quite possibly the largest bar none. Table III draws together returns from car factories, engine builders and railway shops in the 1871 manuscript census. It is clear that the central car and locomotive shops on the two largest railways — the Grand Trunk's at Brantford and Montreal, and the Great Western's at Hamilton — were as big as the largest independent establishments in those industries, and that as *integrated,* multiplant manufacturers the larger railways were bigger by far — in terms just of *manufacturing* employment, consumption of materials, and output — than any of the independent firms. The exclusion of the railway company facilities from the aggregate tables published in the 1871 census reports resulted in a grossly distorted picture of the scale and organization of the Canadian railway supply and heavy engineering industries.[17]

## THE PRINCIPAL SHOPS

In June 1853, the Great Western's chief engineer informed the company's shareholders that their car factory, blacksmith's shops, setting-up shop, paint shops and machine shop at Hamilton were well advanced towards completion, and that similar plans had been approved for London. Later that summer the *American Railroad Journal* reported that GWR machine shops, depots and warehouses were being built, "of a size calculated to astonish even those who had made the largest calculations as to Western progress". The car factory was "not only the largest workshop of the kind, but perhaps, the most extensive manufacturing establishment of any description in Western Canada", exhibiting "the most efficient specimens of labor saving machines that we have ever witnessed".[18]

By 1857, when a local journalist visited the plant, the locomotive shop had between twenty and thirty locomotives under repair daily. Twelve tracks, each capable of holding two engines, passed through the ground floor of the erecting shed.

> The first room we entered seemed to be the general hospital, in which the sick giants were disposed in long rows and supported at a considerable height, on wooden blocks and beams. Passing in we came to two rows of ponderous machines. There were drilling machines, boring holes of various sizes through any

17. "Engine builders" included manufacturers of all manner of steam engines, not merely locomotives. A detailed systematic examination of the industrial schedules for locations other than those surveyed here might well turn up other misclassified and/or omitted establishments. The published report should be used with the greatest caution: Canada, *Census (1870-1)* (Ottawa, 1875), v.3.

18. *CNR* 1, p. 17: Report of John T. Clark, 4 June 1853; *American Railroad Journal,* 27 August 1853.

**Table III: Census of 1871**
**Car Factories, Engine Builders and Railway Shops (see text)**

| Establishment | Total employees | Annual wages | Motive power | Value of material | Value of product |
|---|---|---|---|---|---|
| **1. INDEPENDENT CAR FACTORIES FROM AGGREGATE CENSUS** | | | | | |
| John McDougall & Co., Car Wheel Factory, Montreal (West) | 60 | 36000 | 15 HP | 85000 | 144000 |
| James Crossen, Railroad Car Manufactory, Cobourg, Northumberland Co. | 40 | 12000 | N/A | 22000 | 150000 |
| Toronto Car Wheel Company | 20 | 6000 | 20 HP | 40000 | 54000 |
| A. Holmes, Montreal Car Works, Hochelaga | 20 | 2500 | Manual | 20000 | 120000 |
| Wm Hamilton & Sons, St. Lawrence Foundry, Machine and Car Shop, Toronto (East)[1] | 200 | 100000 | 60 HP | 35000 | 150000 |
| **II. INDEPENDENT ENGINE MAKERS FROM AGGREGATE CENSUS[2]** | | | | | |
| Hyslop & Ronald, Steam Engine Factory, Chatham, Kent Co. | 42 | 18000 | Shared: 50 HP | 6000 | 50000 |
| C.H. Waterous & Co., Manufactory of Steam Engines, Boilers, &c, Brantford, Brant Co. | 118 | 40573 | 40 HP | 19700 | 120000 |
| F.G. Beckett & Co., Manufacturers of Locomotives, Steam Engines, Boilers &c., Hamilton | 120 | 40000 | 50 HP | 40000 | 100000 |
| Charles Levey & Co., Steam Engine Factory, Toronto (West) | 46 | 10000 | 30 HP | 20500 | 70000 |
| Hamilton & Martin, Engine Builders and Machinists, Toronto (East) | 9 | 7000 | 8 HP | 2400 | 25000 |
| Canadian Engine & Machinery Co., Locomotive and Car Factory, Kingston | 173 | 75000 | 20 HP | 201058 | 306000 |
| Davidson & Doran Machine Shop, Kingston[3] | 47 | 11000 | 15 HP | 12000 | 40000 |
| George Brush, Eagle Foundry and Machine Shop, Montreal (West) | 80 | 25000 | 20 HP | 25000 | 80000 |

**Table III: Census of 1871**
**Car Factories, Engine Builders and Railway Shops (see text)**

| Establishment | Total employees | Annual wages | Motive power | Value of material | Value of product |
|---|---|---|---|---|---|
| E.E. Gilbert, Engine and Machinists Works, Montreal (West) | 145 | 50000 | 40 HP | 46500 | 120000 |
| W.P. Bartley & Co., Engine Works and Foundry, Montreal (West) | 222 | 49200 | Water: 160 HP | 36250 | 128175 |
| **III. RAILWAY SHOPS FROM MANUSCRIPT CENSUS** | | | | | |
| Grand Trunk: Point St. Charles shops[4] | 790 | 250000 | 185 HP | 500000 | 750000 |
| Grand Trunk: car and loco shops, Brantford | 315 | 182000 | 30 HP | 82000 | 326000 |
| Great Western Locomotive Shop, London | 34 | 12786 | 35 HP | 2330 | 20000 |
| Great Western: Hamilton return[5] | 984 | 500000 | N/A | N/A | N/A |
| Northern: Toronto (West) return[5] | 561 | 215808 | 139 HP | 34533 | N/A |

NOTES
1. Hamilton's was not included under car shops in the aggregate census. Its return suggests that car building was its principal business at this date, however.
2. One shop in Co. de Quebec and one in Montreal (C), each employing 5 men, are excluded.
3. Not included in aggregate census: principal product seems to be steam engines.
4. "Running shed, Repairs to Engines, Pattern Shops, Brass Foundry, Fitting Shops, Car Shops, Saw & Planing Shops, Blacksmith & Carpenters Shops." The product was reported as "Engines, cars & repairs".
5. These returns seem to include other railway facilities besides the shops. On the Northern's return the enumerator noted that the quantities and value of products could not be ascertained, "as the Company are manufacturers or producers merely on their own Account".

> thickness of metal. There were planing machines which dealt with iron and brass as if they were soft wood, and rapidly reduced the blocks of metal to the necessary form — machines which cut iron as if it were paper, and punched holes through quarter inch plates as easily as you would punch a gun-wad from a piece of pasteboard. Lathes of all imaginable shapes and sizes, for doing all imaginable things, and in short, the complete furniture of a first class establishment.

The upper floor of the building held the carpentry shop, 165 feet long by 83 wide, where lathes, shapers, planers and drilling machines were used to build buffers and cow catchers. The machinery was run by a sixty horsepower engine, built at Chippawa, and shared between the locomotive and car departments, which also shared the services of a brass foundry, a coppersmiths' shop and a smithy in which cranks, wheels and rails were manufactured and repaired in the glow of twenty-five or twenty-six forges.[19]

The car shops built and repaired rolling stock, manufactured furniture for the stations, and cut timber for fences and bridges. In the machine shop cast-iron car wheels were made and repaired with the use of "machinery the most powerful, and at the same time the most delicate. . . . One engine cuts through, with ease, bars of cold iron, an inch thick and three inches broad, while others turn the edges of the wheels so accurately that they do not differ the thousandth part of an inch from a true circle." The car department built baggage racks in the brass foundry, and kept cabinet, upholstery, finishing and paint shops at work, along with shops for making water coolers, signal lamps, stationary signals, hand cars, and gas fittings for stations. There was also a huge body building shop, 300 feet by 50, to assemble the cars.[20]

When Richard Eaton became locomotive superintendent in 1858, he took charge of a planned expansion in the shops' capacity. By midyear he was able to report that the greater part of the improvements had been made: "the steam hammer, tyre furnaces, stores and coppersmith's shop are complete; and the tanks, plates, and crane for fixing and blocking the tyres are also erected and but little remains to complete the blocking machinery. . . . The travelling steam crane for large lathes &c and the few remaining improvements are in a very forward state. . . ." A fifty-hundredweight Nasmyth steam hammer had been ordered from England, and Eaton had a blooming furnace for working up wrought iron scrap installed and in production by the end of the year. The hammer was used to beat the heated scrap into plates an inch thick. A drawing published in 1863 shows it towering four times the height of the men crowded around it, forging a 14 foot, 1600 pound shaft for the stationary engine. Next door was the boiler shop with its riveting machines, drills, and "a large punching and shearing machine which will clip you off a piece of boiler plate half an inch thick and ten inches wide in a shorter time and with less manual labour than is required to cut as much cheese".[21]

A year later, the shops boasted an elaborate heating apparatus, which distributed the waste steam from the stationary engine and steam hammer furnace through a mile of piping; the whole system was extended the following year so that more than two miles of heating pipes snaked their way through the Hamilton works. Eaton undertook an extensive rearrangement of the shop machinery, added a hoist for moving materials between floors, rebuilt some wooden buildings in masonry, and supplied new lathes, new forges for making wrought-iron wheels, and a steam riveting machine for

19. Hamilton *Spectator*, 28 February 1857.

20. Hamilton *Spectator*, 4 March 1857.

21. Hamilton *Spectator*, 7 October 1857; *CNR* 6, 31 July 1858; *CNR* 7, #1308, 17 December 1858; *ibid.*, #1319, 31 December 1858; *Canadian Illustrated News*, 14 February 1863.

iron-bridge construction.[22] A report from late November 1860 gives an impression of the nature and rhythm of shopwork in this period:

> The Plates for Boilers for next pair of Engines have also been ordered from England and will arrive here about the middle of January next, and the Wrought Iron Framing, Driving Wheels and remaining Iron Work, will be put in hand on 3rd December (next Monday) at which time the Blooming Furnace will be put to work in order to use up the scrap iron. The Blooming Furnace will be kept to work until we have provided all the heavy forgings required for new Engines and for general use during the ensuing 12 months. A considerable portion of the Castings required for next year's new Engines are already made and the best use will be made of all the men and machines we can spare from the regular repairs in order to forward the new Engines and other improvements that are being made in the Locomotive Stock.[23]

The plant and equipment were expanded further over the succeeding years. The flooring was relaid and lorrys and tramways installed to expedite the movement of heavy materials and parts. New furnaces for brass moulding and heavy iron work were added. By 1869 the stationary engine required new boilers and pistons, which were built in the shops; when they were completed the engine was fully refitted. New machinery was built or purchased — a radial drill, a screw-cutting lathe, a carwheel boring machine, nut- and bolt-making machinery, an improved hydraulic car wheel press, and a hydrostatic locomotive wheel press. By 1870, when additional carshop facilities were badly needed, there was no room for expansion at Hamilton so work began on a new car facility at London. The following year it became clear that the existing overcrowding at Hamilton posed a serious fire risk, and the Great Western management began to discuss moving the entire car department to London. Two hundred and fifty GWR carshop workers moved from Hamilton to London in November 1874, when this transfer was made; the decision may have been hastened when fire broke out at Hamilton in September 1873, although it caused little damage. In the interim, the Hamilton shops were hard-pressed.[24]

The Great Western established a locomotive repair shop in London as part of its original plant in the 1850s, and for a time the outside locomotive department (locomotive running) was headquartered there. A journalist visiting the works in 1857 described the round-house with its metal-working lathes, drilling and bolt-making machines, and eight blacksmith's forges, whose draft was supplied by a steam rotary

22. *CNR* 7, #1441, 18 November 1859; GWR *Report* for half-year to 31 January 1860; GWR *Reports*, half-years to 31 January 1860 and 31 July 1860; *CNR* 7, #1474, 10 February 1860; *CNR* 6, #1142, 28 November 1860.
23. *CNR* 6, #1142, 28 November 1860.
24. GWR *Reports*, half-years to 31 July 1862, 31 July 1865, 31 July 1869, 31 January 1870, 31 July 1870, 31 January 1871, 31 January 1872 and 31 January 1873; *CNR* 4, #3335, 23 June 1871; *ibid.*, #3341, 29 June 1871; GWR *Report* for half-year to 31 January 1875; London *Advertiser*, 10 and 25 November 1874; London *Free Press*, 11 November 1874; *CNR* 4, #4096, 18 September 1873; GWR *Reports*, half-years to 31 July 1873 and 31 January 1874; *CNR* 8, 5 November 1873.

fan, "for making of that work which cannot be done by machinery". The whole was powered by a sixty-five horsepower horizontal engine. This was evidently a running shop, although some heavy repairs may have been done there, and there was talk at the time of expanding its capacity by introducing steam hammers. Under Eaton's programme of shop improvement, though, the heavy repair work was to be done in the Hamilton shops, and the stationary engine and machinery were removed to the newly consolidated Hamilton works in 1858. "This will make thirty or forty dwellings in the city vacant," complained a local newspaper, "and materially decrease the population, which has already been more than sufficiently thinned."[25]

The tables were turned some fifteen years later when London became the new locale for the Great Western's principal carshops. "The removal of this large population from Hamilton, while depressing matters a little in the ambitious city, has considerably enlivened the town of London East, where the demand for house room is just at present unusually brisk." The total cost of the shops, sidings and machinery amounted to about £50,000, or a quarter of a million dollars. About $150,000 of this was paid to a London contracting firm, Messrs. Christie & Green, while the remainder was accounted for in work done by the Great Western itself and in purchases of new machinery. There were six buildings,

> all of them of extraordinary size, and with the exception of that used for the storage of dry lumber, are built of brick with slated roofs. They cover an immense area of ground, though clustered as closely together as convenience would allow. There is the blacksmith shop, the machine shop, the iron repair shop, the wood-working department, the storehouses for iron, coal, and other necessaries, and the offices, all in close proximity. A huge transfer table is used to convey the work from one department to another, and the numerous rail tracks that are seen in each building show that the shops are intended to accommodate almost any amount of work.[26]

After the car department's move to London, the buildings it had vacated at Hamilton proved to be too small for the locomotive department there to use. In October 1874 two large shops were dismantled, placed on twenty-car trains, and reerected at Suspension Bridge to replace running repair sheds that had been destroyed by fire there. The Great Western's principal locomotive shops remained at Hamilton for some years after the company's absorption into the Grand Trunk system in 1882. In

25. Hamilton *Spectator,* 12 March 1857, copying London *Prototype;* Toronto *Leader,* 7 April 1858, copying London *Journal.*

26. London *Advertiser,* 10 and 21 November 1874; GWR *Reports,* half-years to 31 July 1870, 31 July 1873, 31 January 1874, 31 July 1874, 31 January 1875 and 31 July 1875; *CNR* 4, #4112, 9 October 1873.

1889 their machinery and staff were transferred to the enlarged Grand Trunk motive power shops in Stratford, and the Hamilton shops were closed.[27]

The first substantial railway shops in the Montreal area were those of the Champlain & St. Lawrence, at St. Lambert (South Montreal) across the river from the city. In 1852 the terminus included a machine shop 100 feet by 50, a boiler house 25 feet square, and a blacksmith's shop 50 feet square. Together with the station buildings, engine house and workingmen's cottages they occupied an area of about twenty acres, and promised to be the making of a "handsome compact railway town". In the same year, the St. Lawrence & Atlantic, a Grand Trunk constituent, was soliciting tenders to build a car repair shop at nearby Longueuil. When the Grand Trunk commenced to build its own terminus and shop facilities, however, they were located on the island, at Point St. Charles.[28]

In 1854, when the line was taken over from the contractors, the Grand Trunk's chief engineer explained the works under way at Point St. Charles:

> It is intended to get in the foundations for the Station Buildings, at Montreal, throughout this season, these extend to an aggregate length of 3000 feet, in sundry buildings, varying from 40 to 90 feet in width, some of which are two stories in height, and consist principally of Passenger Stations, Goods Warehouses, Locomotive erecting shops, Engine Stables, Car erecting shops, Smiths, and Foundry shops. It is proposed to complete the Car and Smiths shops this season, so as to admit of commencing the construction of the car rolling stock, which is to be built upon the premises. The remaining buildings of this establishment being so far prepared this autumn, will be readily advanced to completion next year.[29]

By the beginning of 1855, the works were advertising for bolt-makers and coppersmiths, and car building (by contractors) had so far advanced by the spring of 1856 that a shopworkers' protest meeting was held to denounce the *Pilot* and other local newspapers for their disparaging remarks about the quality of the cars. The works had their own sawmill in 1856; by 1857, when the Grand Trunk was building cars on its own account, its locomotive superintendent could speak of the "ample and well appointed workshops" which "have no equal either in extent or in completeness of arrangement on this side of the Atlantic". Some idea of the scale of these works is suggested by a report that they were illuminated by seven hundred gas lights; by 1858

27. *CNR* 4, #3965, 10 April 1873; London *Advertiser,* 16 October 1874; Canadian National Railways Library, Montreal, H. Spencer, "An Historical Review of the Canadian National Railways Motive Power Shops, at Stratford, Ont., from its Inception in 1870 to August 1951", unpublished typescript.

28. Montreal *Gazette,* 2 and 18 February 1852, 10 August and 30 November 1853; Montreal *Gazette,* 17 September 1852. In the United States, the Grand Trunk had substantial engine shops at Gorham, New Hampshire and at Island Pond, Vermont, and a major car shop at Portland, Maine. These American facilities are not discussed further in this paper. Montreal *Gazette,* 15 and 16 February 1855; Montreal *Transcript,* 25 September 1857; GTR *Report,* 1855.

29. GTR *Report,* 1854.

the company was considering spending $20,000 for plant to make its own gas at a price 40 per cent below that charged by the Montreal Gas Company.[30]

When W.S. Mackenzie succeeded Frederick Trevethick as locomotive superintendent in 1859, he predicted the need for substantial additions to and mechanization of the shops, including the introduction of steam hammers, which had come into use on the Great Western the previous year. There appears to be no record of whether he was successful in persuading his Board to update the facilities, but when C.J. Brydges left the Great Western to become the Grand Trunk's general manager in 1862 it quickly became apparent that the company's shop arrangements were in terrible disarray. Brydges appointed Henry Yates and Richard Eaton to investigate the working of the mechanical and fuel departments, and they found room for considerable improvement. Repair facilities were scattered among numerous shops and running sheds along the line, several of them located very inefficiently; responsibility for the car stock was diffused; there was no effective renewals policy in force; the locomotive stock required to be standardized; and the stores department was in total disorder. Most importantly for this discussion, they recommended a thoroughgoing consolidation of repair shops, closing many of the smaller ones, converting others into running shops, and concentrating heavy repairs and car and locomotive building at Point St. Charles.[31]

Under Eaton's superintendency, the facilities and equipment at Point St. Charles were rapidly improved. In 1863 the shops built a 10-inch hydraulic power press and a very large mortising machine, and screwing and drilling machines were purchased. The machinery was rearranged and covered ways were built between the smiths, erecting and machine shops. More repairs were done to the shops the following year, and new lathes and machines were added. In 1865 work on the shops was "extraordinarily heavy", and Eaton reported that the company was deficient in shop room for more than fifty engines. Heavy expenditures on shop facilities and machinery continued throughout the 1860s, and by 1869 work was under way on a new paint shop, 270 feet by 40, and a saw and planing mill, 170 feet by 63, at Point St. Charles.[32]

30. Montreal *Gazette*, 15 January and 2 October 1855, 10 May and 22 July 1856; GTR *Report* for half-year to 30 June 1857; *Journal of the Franklin Institute of the State of Pennsylvania*, 3rd series, 36 (July 1858).

31. GTR *Report* for half-year to 30 June 1859. For an engraving of the Grand Trunk workshops in 1860, see C.P. DeVolpi and P.S. Winkworth, eds., *Montréal: Recueil Iconographique* (Montreal, 1963), vol. 1, p. 137. The Eaton-Yates report was predicated on the contemplated merger of the Grand Trunk and Great Western, so they proposed to make Montreal the focal point for repairs and renewals on the Portland to Toronto section, and Hamilton for the western section. When the merger plans fell through, their major recommendations were adapted for the Grand Trunk alone. *CNR* 1001, 9 June 1862; *CNR* 10190, fo. 77.

32. Canadian National Railways Library, GTR, ms. Locomotive Superintendent's Reports, half-years to 31 December 1863, 30 June 1864, 30 June 1865 and 30 June 1868; GTR *Reports*, half-years to 31 December 1868 and 30 June and 31 December 1869.

New machinery was added in 1870, and in the same year a fireproof storage building for paints and varnishes was erected and a steam-heating system of the same sort introduced on the Great Western was put into operation. In 1872 new machinery was added, the existing machinery was rearranged, and the steam hammer was placed on new foundations. In 1873 the company bought an additional 40.6 *arpents* of land adjacent to the shops from the Grey Nunnery, in preparation for further expansion, and ''extensive additions'' were made during the year. In March 1875, the two principal car shops at Point St. Charles, with all their machinery, were destroyed by fire, but by the end of the year they had been replaced. Two years later the car shops were expanded, and additions were made to various of the locomotive shops as well. Over the course of the next several years, there were substantial additions to the stock of machinery. In 1880, ''in consequence of the greatly increased work being done at Point St. Charles'', the boiler shop was extended 95 feet, the smith's shop 44 feet, the passenger car shop 300 feet, and a new tube shop was erected.[33]

At Brantford, the old Buffalo, Brantford & Goderich company had agreed as one of the terms of its 1854 municipal bonus to erect a ''large and commodious machine shop'' in the town within fifteen months. A paint and finishing shop for cars, 150 feet by 40, collapsed while under construction in 1854. When the BB&G became the Buffalo & Lake Huron in 1856, Henry Yates was hired away from the Great Western to become its mechanical superintendent, and he brought some skilled shopworkers with him from Hamilton. By August of that year, the company's general manager was able to report that ''the workshops are beginning to exhibit some signs of order and arrangement — we are obliged to create everything as we want it'', and by November he expressed great satisfaction at the ''interior economy'' of the shops. The following year, the Brantford works began producing cars for the line, and in 1858 they began rebuilding some old BB&G engines.[34]

When the Grand Trunk absorbed the Buffalo & Lake Huron in 1868 it took over and operated the Brantford shops, leasing the old company's cars from the Brantford Car Company. The railway centralized its locomotive repair facilities at Toronto, transferring most of the engine shop mechanics from Brantford to the shops at Queen's Wharf and placing the former Brantford foreman, Thomas Patterson, in charge. The GTR's Toronto facilities had never been adequate, however; in 1862 Eaton and Yates had singled them out as being the most inconvenient in terms of location and arrangement of any on the line. In the general shops consolidation programme of the

33. GTR *Reports*, half-years to 30 June 1870, 31 December 1870, 30 June 1872 and 31 December 1872; 92 *CNR* 1039, 6 December 1873; GTR *Reports*, half-years to 31 December 1873, 30 June 1875, 31 December 1875 and 31 December 1877; *CNR* 1042, 20 May 1880; GTR *Reports*, half-years to 30 June 1880 and 31 December 1880.

34. Brantford *Expositor*, 14 March 1854 and 15 July 1870; University of Western Ontario, Regional History Collection, published evidence in *Whitehead v. Buffalo*, II, p. 36 (Barlow to Heseltine and Powell, 5 July 1856); II, p. 44 (Barlow to Heseltine and Powell, 16 August 1856); II, p. 55 (Barlow to Powell, 15 November 1856); I, p. 111 (Barlow to proprietors, 16 February 1857); III (*Report* for half-year to 31 July 1857); I, p. 122 (Powell to proprietors, 21 September 1857); III (*Report* for half-year to 31 July 1858).

early 1870s it became apparent that Toronto offered insufficient room for expansion, and Stratford, at the geographic centre of the district, was selected as the site for new locomotive repair shops. Construction began in June 1870 on a 300 foot by 90 workshop building, a storehouse 100 feet by 40, and a roundhouse; all were of brick on cut stone foundations. The shops were illuminated with ten thousand panes of glass (most of which were to be broken in a hailstorm three years later), and a local firm got the glazing contract. Another won the contract to supply castings. When the Stratford shops were completed in 1871, the Queen's Wharf machinery and workforce were transferred there, again under Patterson's general foremanship.[35]

The same consolidation programme saw Brantford chosen as the site for a new freight car factory, constructed by Henry Yates at a cost of $31,000. When it began operations in 1871 the Brantford works was the largest in Canada. Capable of admitting fifty cars at a time, it was "provided with every possible labour-saving convenience, the machinery from the old shops having been transferred to it, and arranged to the best advantage, in order to facilitate the preparation of material and to reduce the cost of repairs". Besides carrying out a substantial proportion of the GTR's car repairs, Brantford was to be the company's chief freight car building facility. The "monster workshop" was 336 feet by 144, and 21 feet high. It had five sets of track running along its length and one across its width, with turntables at every intersection. The outside tracks were for repairing Pullman cars, and the three inside ones for freight car building and repair. It was built of brick on stone foundations, and with an iron-truss roof containing seventeen skylights of about 150 square feet each; additional illumination was provided by fifty-four windows. A 30 foot by 20 foot engine room, complete with "monster smoke stack, such as one has never before seen in Brant City", was connected at one side. On the same site stood the old engine house, now converted for car repairs, and a number of specialized workshops, stores buildings and machine rooms.[36]

## SHOP PRACTICE

It remains to consider briefly some features of organization and practice that characterized the railway shops in the years before 1880. A substantial amount of technological innovation took place in the shops, not only in the form of "tinkering", but also in terms of systematic experimentation. Alongside this must be placed a dual concern with standardization, first with regard to the economy of interchangeable parts, and second to the standards which were imposed by necessity where several companies shared traffic and equipment. These industry standards sometimes restricted innovation. Finally, shop practice was informed throughout by an anxious

35. *CNR* 10190, fo. 77. See generally, H. Spencer, "Canadian National Railways Motive Power Shops", p. 113, Stratford *Beacon*, 12 August 1870, 4 November 1870, 11 November 1870, 11 April 1873, 16 May 1873, 13 June 1873 and 18 July 1873; Stratford *Herald*, 15 June 1870 and 10 and 24 May 1871.

36.. *CNR* 1038, 6 May 1871; Brantford *Expositor*, 7 October 1870, 2 June 1871, 14 July 1871 and 28 July 1871; GTR *Report* for half-year to 31 December 1871.

interest in cost-saving. This found expression not only in the extensive recycling of old equipment and materials and the introduction of labour-saving machinery, but also in the evolution of relatively sophisticated cost-accounting methods and the development of renewals policies.

Most of the mechanical superintendents and at least some of the foremen developed and often patented technological innovations, many of which found their way into the everyday practice of the shops. To take only a few examples among many, Richard Eaton patented a steel locomotive boiler and heater, Henry Yates an improved firebox, and Samuel Sharpe a lateral motion truck and a ventilating apparatus for passenger cars. W.A. Robinson invented a rear-view mirror for engine cabs, Great Western engine shop foreman Joseph Marks had several patents to his credit, including a spark-arresting smokestack that was widely advertised in the industry press, and a Grand Trunk locomotive shop foreman (subsequently foreman of the Kingston Locomotive Works) named Nuttall invented a car lifting and truck transfer device which was indispensable to the company's operations during the transitional years of the gauge change.[37]

Innovation was accompanied by rigorous experimental testing of certain kinds of equipment. The best example is likely wheels, for the debate over the relative merits of cast iron and wrought iron wheels, and of steel tyres, continued over the whole period. To some degree the technical questions were tangled up with the rival claims of British suppliers and North American practice, for wrought iron had become so firmly established as the British standard that the Canadian railways' British proprietors were susceptible to enthusiastic lobbying by English and Scottish manufacturers. In 1856 the Great Western's directors decided to replace cast iron driving wheels with English wrought iron wheels, "which, it is expected, will have a very beneficial result, both in respect to safety and ultimate cost for repairs". But three years later Robert Gill, chairman of the railway's English board, told the shareholders that "it was a very extraordinary fact that these wheels, which were cast in America, with charcoal, were found to be more durable and less liable to accident than wrought iron wheels. . . . It was a long time before the Board would give in, but at length they were obliged to let the fact of the small percentage of breakage of these [cast iron] tyres prevail over their own prejudices."[38]

37. *The Engineer* (London), 9 March 1860, p. 155; *Whitehead v. Buffalo*, III, *Report* for half-year to 31 January 1858; Montreal *Transcript*, 6 November 1857; Hamilton *Spectator*, 28 August 1860 and 27 April 1863; *Canadian Illustrated News*, 6 December 1862; *Canadian National Railways Magazine*, August 1934; *American Railway Review*, 5 (1862), p. 210; Stratford *Beacon*, 1 August 1873, and see Montreal *Transcript*, 8 October 1857; *CNR* 1039, 3 June 1873.

38. *CNR* 1, Report of R.W. Harris, 12 March 1856; *ibid.*, Car Superintendent's Report, 18 February 1859; Hamilton *Times*, 26 April 1859. Discussions of the inadequacies of wrought iron wheels and the superiority of cast iron occur regularly in the mechanical superintendents' half-yearly reports; the most common problem with the English wheels was their high rate of winter breakage.

This hardly ended the affair, however, for the wheels question was placed on the agenda of practically every shareholders' enquiry into the workings of the Canadian railways. The mechanical departments responded by manufacturing their own wheels in both cast and wrought iron, ordering test quantities from various manufacturers (including, in 1869, the Intercolonial Iron and Steel Company of Londonderry, Nova Scotia), and conducting exhaustive tests. The battle was still raging when, in 1873, the Grand Trunk's president invited the proprietor of an English railway car company to visit Canada and report on the GTR's rolling stock. He reported in favour of his own brand of wheels and tyres, saying "it is almost impossible to estimate the evil effects of the use of Cast Iron Wheels upon your permanent Way. . . . I have no doubt that it would be found that the use of Cast Iron Wheels has been the cause of thousands of rails breaking. . . . I consider it would be an act of barbarism to destroy that road by perpetuating the use of your Cast Iron Wheels."[39]

The GTR management accordingly ordered another test of the English wheels, and two years later mechanical superintendent Wallis supplied an exhaustive accounting of every wrought iron wheel removed from service in January 1875, showing the nature of the defect and the number of miles run, and comparing the experience of wrought and cast iron wheels. This was only the opening salvo in an exchange of information and opinion that lasted for most of the year and resulted in general agreement among the company's officers in Canada that the existing types of English wheels were impracticable. In September the Grand Trunk managers awarded contracts to Canadian firms for the supply of cast iron engine, truck and car wheels, but agreed to try a further test of twelve English wheels with steel tyres, made to the mechanical superintendent's new specifications. These were evidently a success, for at the end of 1877 the locomotive superintendent reported that "with regard to our Passenger Cars, we have, after two years' trial, adopted the standard English steel tyred car wheel of 43 inches diameter, in place of the cast iron chilled wheel of 33 inches, and so far as introduced these wheels have given satisfaction, having produced a marked general economy and improvement."[40]

The technological sophistication of the locomotive and car departments and their interest in mechanical invention and improvement seems to run contrary to T.C. Cochran's judgment that innovation was a talent not much looked for in American railway managers because of the difficulty of gaining competitive advantages in an industry that placed such a premium on cooperation. But in Canada at any rate, the relationship between innovation and interindustry cooperation was fairly complex. Over the period, it was indeed increasingly true that the need to accommodate

39. University of Western Ontario, Regional History Collection, Thomas Swinyard Papers, v. 1430, Swinyard to Livesey, 28 December 1869; *CNR* 1039, 22 October 1873; London *Advertiser*, 19 March 1874.

40. Canadian National Railways Library, Wallis to Hickson, ms. report on steel wheels, 2 and 3 March 1875; *ibid.*, ms. bundle, "Correspondence and Reports on English Steel Tyred Wheels", Hannaford to Hickson, 26 August 1875; *CNR* 1040, 21 September 1875; GTR *Report* for half-year ending 31 December 1877.

"foreign" traffic, and to have the company's rolling stock operate on "foreign" lines, precluded certain unilateral changes. On the other hand, technological superiority occasionally led to interindustry cooperation, as when the Grand Trunk agreed to let the Great Western run over its line to Portland for a year, in exchange for having the GWR mechanical department build it a terminal elevator at Toronto. And the need to conform to industry-wide standards could sometimes be a positive spur to innovation, as for example with the variety of appliances developed on both the Grand Trunk and the Great Western to cope first with breaks of gauge with connecting lines, and subsequently with breaks of gauge on their own main lines once the project of changing to the standard North American gauge was begun.[41]

Most significantly, though, technological developments were crucial to the railways' continuing efforts to reduce their costs. Certainly the attention of those in charge of the mechanical departments was constantly drawn to the need for reducing costs; indeed, it was the perception that in-house production could lead to substantial economies that accounted for the railways' role as large-scale manufacturers in the first place. But a sophisticated mechanical superintendent realized, and considered it part of his job to persuade his general manager and board of directors, that true economies could not be secured through simple cost-cutting. "No exertions or expense has been spared, in order to increase the efficiency and durability of the Engines," Eaton reported, "because such is the only way to effect real economy, and advantage to the Company. Our general reductions in expenses are due to the prevention of waste, and not to any false economy in repairs."[42]

Achieving "real economy" was an extremely complex task. Among its components were the establishment of standards permitting mechanization and interchangeability of parts, rational shop arrangement, the reduction of waste through heroic efforts at recycling used materials, experimentation with new materials and techniques, and effective accounting for expenditures and depreciation. Taking all these elements together, advanced railway shop practice in the three decades before

41. Thomas C. Cochran, *Railroad Leaders, 1843-1899* (Cambridge, Mass., 1953), p. 147ff.; GTR *Report* for half-year to 31 December 1877. The argument that interdependence of firms prohibited unilateral innovation was advanced by several railway managers to excuse their failure to introduce certain safety appliances that might reduce the frequency of accidents to brakemen; see Ontario, Select Committee on Railway Accidents, *Report*, 1880, *passim; CNR* 7, #1617, 18 October 1861.

42. GWR *Report* for half-year to 31 January 1862; Canadian National Railways Library, GTR, ms. Locomotive Superintendent's Report for half-year to 30 June 1864.

1880 bore a striking resemblance to several of the important "discoveries" of the new industrial management theorists of the early twentieth century.[43]

Standardization of equipment and parts was an important aspect of workshop economy. "Nothing tends so much to increase the working expenses of the Locomotive Department in this Country than by the adopting or ordering more than two or at most three classes of Engines," reported Eaton and Yates in 1862. "However great a number may be required they should be of one build and design, for apart from the comparatively smaller expenditure required for Patterns, Castings, Spare Gear, &c necessary to be kept always on hand, the advantages and saving arising from the use that could be made of parts of Engines under repairs during the Winter to meet emergencies could be of the greatest possible benefit to the Company."[44]

They estimated that standardization would reduce the proportion of engines under repair by at least 20 per cent, and would mean extensive savings in labour and materials costs. They noted that the Grand Trunk locomotives were of a "great variety of Patterns and build which have been supplied from no less than fourteen different establishments, the varieties of Engines being still further increased from the fact of several of the same firms having furnished several lots of Engines of different kinds, from designs of their own, some of which have been found quite unsuitable for the road and Traffic, until important alterations and additions had been made by the Company," a fact which of course further varied the stock. Indeed, the more different kinds of engines a railway possessed, the more engines it needed to do the work because it could not achieve speed and efficiency in upkeep and repair.

Eaton and Yates recommended that a uniform standard for all leading dimensions be established and adhered to in altering the present stock and supplying new engines, so that in the course of time "a tolerable near approach to uniformity" might be achieved. Both the Grand Trunk and the Great Western adopted such standards for building new engines in their own shops, and they supplied specifications to the Kingston Locomotive Works as well. By 1868 the Great Western had five of these built at Kingston: "they are similar in all essential parts to the new standard freight engines built in our own works, with which their parts are interchangeable." The shops seem to have managed a judicious balance of standards and innovation. "I am

43. A very important difference, however, arose from the fact that "scientific management" assumed a fully formed labour market, while the railway managers had to incorporate the retention of skilled workers into their economy project. But by the late 1870s this was beginning to change, and the railway shops found it possible for the first time (with some minor exceptions in the crisis of the late 1850s) to reduce the size of their workforces, where earlier they had only reluctantly reduced the length of the working day. In terms of *labour* management, then, it would strain the argument to say that the railways of the 1860s and 70s anticipated scientific management, but in terms of industrial organization and cost-control methods of other kinds, they were in the vanguard of managerial innovation.

44. *CNR* 10190, fo. 77, 31 May 1862.

using every means to secure a powerful Engine having only a moderate weight,'' wrote Eaton in 1867. ''For obtaining this desirable object we are making the Boiler and other available parts of Steel, and substituting wrought- for cast-iron wherever it is possible to do so. I may also state that although differing in some details all the essential parts — such as wheels, axles and Machinery — will be strictly uniform with the Grand Trunk standard.''[45]

Rational shop arrangement and recycling waste also produced efficiencies and economies. As we saw in the earlier discussion of the development of the railways' physical plant, the mechanical superintendents often rearranged their heavy machinery, sometimes in concert with the development of new equipment, and introduced hoists, tramways, overhead cranes and other appliances for the easy movement of heavy machines and materials. The kind of savings such integration involved is suggested by Eaton's account of the new furnace installed to heat scrap to be worked by the Great Western's steam hammer in 1858:

> The objects aimed at were, to get the fullest possible benefit from the enormous amount of waste heat evolved from the furnace, and we shall be able not only to raise steam for working the Steam Hammer, but there will be an overplus to assist the Stationary Engine, instead of taking from it as before, and from the same waste heat we shall be able to do all the Spring Makers Work and to re-heat for forging the same quantity of iron which is done by one of our largest Smiths Hearths, consequently saving the amount of Coal used by that hearth.[46]

Along with shop rearrangement went the shops consolidation programmes undertaken by both the Great Western and the Grand Trunk. The effects of these have already been described; their purpose was stated succinctly by Eaton and Yates when they recommended that car renewals and repairs be concentrated at Point St. Charles, ''where under a well regulated System with every appliance in the way of tools and machinery, the work can be done at a much less cost than by workmen employed at out of the way stations and under no regular supervision''.[47]

Efficiencies and economies were also accomplished by recycling waste. The steam heating system installed at Point St. Charles was fuelled exclusively by sawdust and small cuttings from the woodworking shops. Eaton reported of the first engine constructed by the Great Western that ''the Framing has been made by ourselves from our own scrap iron, the inside and outside connecting rods and the valve motion &c are

45. Canadian National Railways Library, GTR, ms. Locomotive Superintendent's Reports, half-years to 31 December 1864 and 30 June 1867; GWR *Report* for half-year to 31 July 1868.
46. *CNR* 7, #1319, Locomotive Superintendent's Report for half-year to 31 December 1858. One of the fullest discussions available of railway workshop layout was published by the Grand Trunk's Master Mechanic at Stratford in 1889; see J. Davis Barnett, ''Work Shops, Their Design and Construction'', Engineering Institute of Canada, *Transactions,* 3 (1889), p. 1.
47. *CNR* 10190, fo. 77, 31 May 1862.

made from worn out Lowmoor Tyres, the Piston Rods and Slide Bars we have made from old broken springs, and the greater part of the Cylinders consist of old Car Wheels, there being no better metal in the world for that purpose." Two years later he was proposing to use the machinery from one or two old locomotives to drive the company's proposed rolling mills. In 1874 the Grand Trunk's mechanical superintendent proposed to convert sufficient broad gauge car trucks to the standard gauge to be used for about one thousand new cars; some of the new car bodies would be built in the GTR shops and others would be contracted for. The same year, the Grand Trunk's storekeeper noted that "it will not be necessary to contract for Washers as they can be more economically made in the Company's shops out of the old sheet Iron on hand by the breaking up of the old broad guage [*sic*] tenders."[48]

Railway shop accounting is really a subset of the much larger topic of railway accounts and statistics generally, a subject too broad to be considered fully here. Concern about the keeping of adequate workshop accounts began with the inception of railway operations; in December 1854, some months before the Great Western's board decided on a policy of tendering for expenditures over £1000, it instructed the managing director and secretary to report "as early as possible upon the system of accounts to be kept in the Mechanical Department". Shop bookkeeping seems to have involved establishing a separate account for every piece of rolling stock (adjusted from time to time by a census of cars), along with additional accounts for major pieces of machinery, for tools and for general shop maintenance. Wages and the cost of materials for repairing the stock would be charged to the appropriate account, so that it was possible, however tediously, to establish the costs of repair (and of running) for each item or class of equipment, compile comparative statistics such as those already discussed for wrought iron versus cast iron wheels, and to prepare, as a matter of course, half-yearly tabulations of costs of various kinds per mile run in the various types of service. By 1875 at the latest, shopworkers' daily work records were organized so as to show the allocation of working hours to each item of equipment. In principle, this might have enabled long-term efficiency checks on individual workers, or the tracing of faults in workmanship back to the individual responsible, although there is no evidence that such use was in fact made of these records. In any event, the detailed record-keeping systems in use in the railway shops and, with a complex system of cross-accounting, in other branches of the railway service, amounted to real cost-accounting, far removed from the simple double-entry bookkeeping systems that characterized most other industry in the period. This accounting system was the backbone of shop practice, for without it the superintendents' claims to be achieving real economies through judicious expenditure could hardly have been justified.[49]

---

48. GTR *Report* for half-year to 31 December 1870; *CNR* 7, #1467, 27 January 1860; #1643, 15 January 1862; *ibid.*, #1039, 2 October 1874 and 23 Septembér 1874.
49. *CNR* 2, #501, 5 December 1854; the tendering policy was adopted in May 1855 (*ibid*, #662); GTR *Report* for half-year to 30 June 1859; Hamilton Public Library, GWR, ms. locomotive shop work records, 1875; on accounting practices in contemporary industry, see A.D. Chandler, *The Visible Hand* (Cambridge, Mass., 1977), p. 69ff.

## SUMMARY AND CONCLUSIONS

While the railways have long been a favourite topic of Canadian economic historians, little attention has been paid to aspects of their activities other than finance and construction. For the most part, they have been viewed as transportation companies pure and simple. But this distorts the reality: the major railways were transportation companies, to be sure, but they were very large, vertically and horizontally integrated transportation companies, whose activities covered a much broader range of economic endeavour. In the period before the National Policy (and perhaps for many years later as well) the major railways were, *inter alia,* among the biggest manufacturing firms in the economy.

From the beginning, the railway companies erected the plant to build their own cars, leasing it to independent contractors. They took over these car works and operated them themselves for three principal reasons. First, they considered (with good reason given that they already owned the physical plant and had a substantial workforce engaged in repairs) that they could build cars more cheaply than the contractors. Second, they were unhappy with the quality of the contractors' product. Finally, manufacturing activity of this sort offered alternative employment for shopworkers in periods of slack traffic, thereby protecting the railways' substantial investment in labour recruitment. From manufacturing cars it was a short step to manufacturing locomotives and other railway equipment as well, wherever it was cost-effective, in the broadest sense, to do so.

With the growth of the system, the scope of shopwork expanded. Parts and components that had formerly been purchased from outside suppliers as a matter of course, and had often to be imported at great expense and with some uncertainty, were now frequently made in the railways' own works. Heavy investments in new shop capacity were made, and existing facilities were consolidated and modernized. Operating under an imperative to keep costs low, both in shopwork and in the train running that it supported, the works invested heavily in machinery, some of it made in the shops, attempted to improve the efficiency of equipment through innovation, experiment and exhaustive testing, and instituted sophisticated systems of cost control. As a result, the railway shops were not only among the largest manufacturing establishments in the Canadian economy, but were among the most advanced technologically and managerially as well.

If this is accepted, then it appears evident that traditional views of the railways' place in Canadian industrialization require some revision. The distinction between "commercial" railways and "industrial" factories is plainly absurd, and should be abolished. The view that the railways' contribution to industrialization consisted of expanding the effective market for domestic industry is no longer adequate. It must be supplemented by enquiries about the interaction between the railways' manufacturing activities and the rest of the industrial economy. In particular, the broader industrializing effects of the railways' shop location decisions, in terms of the local labour force, sources of supply (including the surplus materials and equipment that the railways placed on the market), and the independent railway supply industry deserve examination. It may be that in the final analysis one of the critical questions to be asked about the development of Canadian manufacturing is why other producers in the economy took so long to follow the railways' lead.