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Creating a New Staple: Capital, Technology, and Monopoly in British Columbia's Resource Sector, 1901-1925

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See table of contents

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Article abstract

This paper examines the mining industry of British Columbia, the province's leading staple during the period when the region was brought within the network of world trade. Specifically, it describes the emergence of zinc production as the most profitable sector of the industry, from the early 1900s through to the mid-1920s. A good deal of importance was attached to discovering some means of treating zinc ore in the early 1900s. Increasing amounts of zinc were being found in the silver-lead ore of eastern British Columbia. Zinc was seen as a contaminant, and smelters penalised mine-owners who shipped ore that was over 10 per cent zinc. The presence of zinc rendered relatively valuable ore (in terms of its silver and lead content) uneconomical. Concern over "the zinc problem" was such that, by 1905, the federal government, responding to the lobbying efforts of mine-owners, appointed a commission "to Investigate the Zinc Resources of British Columbia and the Conditions Affecting Their Exploitation". During the next twenty years, mining companies in the Kootenays explored a number of different ways to overcome zinc's unfortunate impact upon the mining industry.

These efforts to discover an adequate means to treat zinc ore illustrate the way in which technology and capital became the key ingredients of a distinctively new mining industry. The paper argues that the emergence of zinc mining reflected a fundamental restructuring of the industry, as the focus shifted from the discovery and exploitation of bonanza deposits of gold and silver to the less spectacular production of copper, lead, and zinc. Technology, economies of scale, and substantial capital investment were the hallmarks of the new industry. Not only was the industry profoundly altered — experiencing what other scholars have described as the second industrial revolution — but new vertically integrated companies displaced the traditional mining company.

The paper describes the clearest example of this trend, outlining the early career of the Consolidated Mining and Smelting Company of Canada [Cominco], a subsidiary of the Canadian Pacific Railway. Cominco was able to put in place the necessary technology to tap its enormous lead-zinc deposit at Kimberley, and successfully treat zinc at its Trail refinery. Within two decades, and largely as a result of its ability to treat zinc, Cominco became the most profitable mining company ever to operate in British Columbia. The conclusion suggests some consequences of Cominco's ascendancy.

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JEREMY MOUAT

Résumé

This paper examines the mining industry of British Columbia, the province's leading staple during the period when the region was brought within the network of world trade. Specifically, it describes the emergence of zinc production as the most profitable sector of the industry, from the early 1900s through to the mid-1920s.

A good deal of importance was attached to discovering some means of treating zinc ore in the early 1900s. Increasing amounts of zinc were being found in the silver-lead ore of eastern British Columbia. Zinc was seen as a contaminant, and smelters penalised mine-owners who shipped ore that was over 10 per cent zinc. The presence of zinc rendered relatively valuable ore (in terms of its silver and lead content) uneconomical. Concern over "the zinc problem" was such that, by 1905, the federal government, responding to the lobbying efforts of mine-owners, appointed a commission "to Investigate the Zinc Resources of British Columbia and the Conditions Affecting Their Exploitation." During the next twenty years, mining companies in the Kootenays explored a number of different ways to overcome zinc's unfortunate impact upon the mining industry.

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I am grateful to Athabasca University's Academic Research Committee for an award which permitted me to undertake the research which forms the basis of this paper, and to my friend Carol Schafer for editorial advice and assistance.

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Cet article porte sur l'industrie minière en Colombie-Britannique, le secteur qui devait fournir le principal produit commercial de la province au moment de sa percée sur les marchés internationaux. Plus particulièrement, l'auteur se penche sur l'essor, entre 1900 et 1925, de la production du zinc qui deviendra le secteur le plus rentable de l'industrie minière.

Au début du XX^e siècle, on déploie beaucoup d'efforts pour transformer le zinc, car sa présence malencontreuse se fait de plus en plus sentir dans les gisements d'argent et de plomb de l'est de la Colombie-Britannique. Le zinc est alors considéré comme un déchet et les raffineries pénalisent les propriétaires de mines qui livrent du métal en contenant plus de dix pour cent. La présence de zinc rend peu rentables les gisements d'argent et de plomb. Le problème du zinc soulève tellement de préoccupations que le gouvernement fédéral, en réponse aux pressions des propriétaires de mines, met sur pied en 1905 une commission d'enquête sur les gisements de zinc en Colombie-Britannique et leur exploitation. Au cours des vingt années suivantes, les compagnies de la région des Kootenays chercheront par tous les moyens à surmonter les effets néfastes du zinc sur l'industrie minière.

Les recherches sur la transformation du zinc montrent comment la technologie et le capital sont devenus les piliers d'une nouvelle industrie minière. L'auteur affirme que l'exploitation du zinc a entraîné une restructuration fondamentale de l'industrie, puisque cette activité économique, auparavant basée sur la découverte fortuite et l'exploitation des filons d'or et d'argent, s'est déplacée vers l'exploitation plus rationnelle du cuivre, du plomb et du zinc. La technologie, les économies d'échelle et les capitaux massifs constituent les caractéristiques de cette nouvelle industrie. Ce secteur industriel s'est transformé radicalement, pour s'inscrire dans ce que les universitaires appellent la seconde révolution industrielle, et la concentration verticale de certaines entreprises leur a permis de déloger les compagnies minières traditionnelles.

En brossant un tableau des débuts de la Consolidated Mining and Smelting Company of Canada *(*Cominco*), filiale du Canadien Pacifique, l'auteur présente le meilleur exemple de ce mouvement de concentration. Cette compagnie fut en mesure de réunir la technologie nécessaire à l'exploitation des larges gisements de plomb et de zinc à Kimberley et au raffinage du zinc à Trail. En moins de deux décennies, et grâce surtout au raffinage du zinc, la* Cominco *devint la compagnie minière la plus rentable de la Colombie-Britannique. La conclusion examine certaines conséquences de la croissance de la* Cominco.

Between 1901 and 1925, the mining industry in British Columbia was transformed as the high-grade precious-metal extraction typical of the late-nineteenth century gave way to operations that relied on low-grade ore. The consequences of this shift were profound, from changes in the nature of the work underground to major modifications in the struc-

ture of ownership and control.[1] By the early 1920s, for example, large corporations based in either central Canada or the United States had become key players within the industry. Smaller mining companies continued to exist, but they assumed a much lesser role, their declining importance hastened by a new emphasis on economies of scale, vertical integration, and the use of sophisticated technology. The emergence of a new branch of the industry – the extraction, concentration, and refining of zinc ore – is perhaps the best example of the process as well as the consequences of the restructuring of mining. This paper presents a chronological narrative of that development and argues that its impact has not been adequately understood by earlier historians. In fact, the major resource industry of the province experienced what can be described as Canada's second industrial revolution.[2]

Statistics suggest significant changes in the mining industry during the first twenty-five years of this century. In 1901, the overall value of mineral production in the province (excluding coal and placer gold) was slightly over thirteen million dollars. Gold contributed 33 per cent of this figure, silver 19 per cent, copper 34 per cent, and lead 15 per cent. The picture had not changed dramatically by 1913: the total value had climbed to just over seventeen million dollars, with gold accounting for 33 per cent, silver 11 per cent, copper 41 per cent, lead 13 per cent, and zinc 2 per cent. After another twelve years, however, the numbers had shifted markedly. In 1925, the total value of mineral production in British Columbia had nearly tripled, to over forty-six million dollars, but the real change was in the relative contribution of the various minerals. Together, gold, silver, and copper accounted for less than 50 per cent of the total, compared to 85 per cent in both 1901 and 1913. Lead and zinc production had now become the most lucrative activity, representing some 57 per cent of the value of the province's mineral output[3] and, in 1925, lead and zinc production was largely the preserve of one company, the Consolidated Mining and Smelting Company of Canada Limited (hereafter Cominco)[4], a subsidiary of the Canadian Pacific Railway.

Cominco emerged at the end of the interwar period as the most successful mining company to have operated in British Columbia. By 1941, its dividends very nearly equalled those paid out by all other mining companies that had been active in the province to that date. As late as 1966, a government publication credited the company with having produced "nearly one half the metal wealth of British Columbia."[5] Such prosperity had

1. For an excellent discussion of the shift to mass mining techniques, see Logan W. Hovis, "Technological Change and Mining Labour: Copper Mining and Milling Operations at the Britannia Mines, British Columbia, 1898 - 1937," MA thesis, University of British Columbia (hereafter UBC), 1986, especially 1-50.
2. For a recent analysis, see Craig Heron, "The Second Industrial Revolution in Canada, 1890-1930," in *Class, Community and the Labour Movement: Wales and Canada 1850-1930*, eds. Deian R. Hopkin and Gregory S. Kealey (Wales, 1989), 48-66.
3. Statistics are from "Table VI - Production of Lode Gold, Silver, Copper, Lead, and Zinc," British Columbia, *Annual Report of the Minister of Mines for... 1941* [hereafter *BC Mines Annual Report* and year], A14-15.
4. Cominco was long the vernacular term for the company (and, in fact, its cable address), although it did not become its official name until 1966.
5. For statistics on Cominco's share of the dividends produced by British Columbia mining companies, see the table compiled by the Department of Mines in 1941, which indicates that to that

not been a certainty, however, until the company was able to exploit the massive lead-zinc ore body at its Sullivan mine and to treat zinc successfully at its Trail refinery. The company accomplished these aims by 1923, and only then was its future assured. By 1925, the soaring value of Cominco shares foretold the profitable future that lay ahead.[6]

Cominco succeeded where others failed. Particularly notable was the inability of local business elites and provincially based companies to assume the leading role in the province's mining industry. Even though these groups were able to call on both federal and provincial governments for assistance, control of what was fast becoming the most profitable sector – the zinc-lead industry – was firmly in the hands of a large eastern-based corporation. This situation reflected, in part, the cost of increased specialization. Substantial capital was needed to support the extensive programme of research which the industry now required, and to profit from economies of scale by combining an efficient transportation network with mining, concentrating, smelting, and refining operations, as Cominco was able to do with its plant at Trail, its facilities at Kimberley, and the connecting rail link owned by its parent company, the Canadian Pacific Railway. Local investors could not hope to mobilize such resources. The First World War also placed local interests at a competitive disadvantage as the need for extensive supplies of zinc, lead, and copper predisposed the federal government to favour large firms when it negotiated sizable munitions contracts.

Features that marked the new mining industry in the province had become characteristic of the international mining world by the early 1900s. These features included vertical integration, powerful corporations dominated by metropolitan capital and control, and a new reliance on economies of scale (often achieved by implementing new technology and by restructuring the work-place[7]). Such developments were not confined to British Columbia, however. The following narrative describes not only the emergence of an important new sector within British Columbia's leading resource industry, but also the way in which the province's economic development followed a pattern discernible from other resource-extractive regions.[8]

i

In the buoyant 1890s, the province's mining industry appeared destined to rival those of Australia and South Africa. Company after company appeared on the London Stock Exchange as bonanza deposits of silver and lode gold were discovered. British Columbia

date virtually one-half of all dividends paid out by British Columbia mining companies (including coal) were paid to Cominco shareholders: "Table XVII. - Dividends Paid By Mining Companies, 1897-1941," *BC Mines Annual Report*, 1941, 18-20. The quotation is from R. J. W. Douglas, ed., *Geology and Economic Minerals of Canada* (Ottawa, 1970), 504. There is no thorough history of the company, but see Jeremy Mouat, "Mining in the Settler Dominions: A Comparative Study of the Industry in Three Communities from the 1880s to the First World War," PhD diss., UBC, 1988, especially Chap. 4, "The Emergence and Growth of Cominco."

6. See the graph of Cominco share prices attached to this paper as an Appendix.
7. See Logan W. Hovis, "The Origins of 'Modern Mining' in the Western Cordillera, 1880-1930," unpublished paper presented to BC Studies Conference, Victoria, 1986.
8. On this common trajectory, see Christopher Schmitz, "The Rise of Big Business in the World Copper Industry 1870-1930," *Economic History Review* 2nd Series, 39:3 (1986): 392-410.

shares soon changed hands in a special niche there, next to the "Kaffir market," where South African mining shares were traded. Central Canadian newspapers published breathless accounts of the wealth of the Kootenays and, in Britain, a special journal appeared, devoted to resource investment in the province.[9] The high expectations of the 1890s were dashed, however, in the first years of this century. Prolonged industrial disputes in the Kootenays, a precipitous collapse in the shares of virtually all of the province's mining companies listed on the London Stock Exchange, and declining values in the mineral content of the ore contributed to the gloom.

The difficulties suffered by the industry were brought to the attention of the federal government in 1901. Representatives of the Slocan-area mines requested financial assistance from Ottawa to bolster the faltering local economy. These representatives claimed that the growing monopoly of the American Smelting and Refining Company (ASARCO) south of the border hindered the efforts of Canadian producers to market lead ore, so they lobbied for a bounty on lead produced and refined in Canada.[10] The federal government accepted their proposal, and a lead bounty took effect in 1902. The bounty involved an initial payment of five dollars for each ton of lead produced at a Canadian refinery, with the proviso that the lead be mined and smelted in Canada. The programme had a five-year limit, and no more than one hundred thousand dollars would be paid out during any one year. The tonnage bonus would be reduced annually; that is, it would be five dollars a ton for 1902, four dollars in 1903, and so on. For this apparent abandonment of their free-trade principles, Prime Minister Laurier, Richard Cartwright (Minister of Trade and Commerce), and William Fielding (Minister of Finance and the bill's sponsor) received the sarcastic congratulations of the Conservative opposition. "I will not discuss the theoretical question of whether this is in line with protection or not," Laurier responded wearily. "The only point that seems to be apparent is that everybody wants a bounty for himself."[11] Over the next several years, however,

9. The extent of British investment in BC mining shares is discussed in *The Mineral Industry* 5 (1896): 667-68; *Engineering and Mining Journal* 65 (8 Jan. 1898): 45; and John Spencer Church, "Mining Companies in the West Kootenay and Boundary Regions of British Columbia 1890-1900 — Capital Formation and Financial Operations," MA thesis, UBC, 1961, passim. A description of the BC section of the London Stock Exchange may be found in Charles Duguid, *The Stock Exchange*, 2nd ed. (London, 1904), 11. For a typical example of Ontario coverage of mining in the Kootenays, see "Hills of Gold" ("Richest in the World.... Mines Out of Which Millions Will Be Made") *Globe* (Toronto), 11 July 1896; note also the comments of Michael Bliss, *Northern Enterprise: Five Centuries of Canadian Business* (Toronto, 1987), 316-17. The British journal was *The British Columbia Review*, "Devoted to the Mining & Commercial Interests of the Province." Launched on 3 April 1897, the journal changed its title on 9 March 1901 to *BC Review*, with subtitles indicating a revealing change of emphasis: "British-Canadian," "British Columbian," "A Weekly Chronicle of the Growth of Canadian Enterprise." It finally ceased publication in September 1905.

10. See Canada. House of Commons, *Debates*, 1901, Vol. II, 21 May 1901 (hereafter *Debates*): 5716-29; *Morang's Annual Register of Canadian Affairs* (1901): 55-56; and Alfred C. Garde, "Notes on the British Columbia Zinc Problem," *Journal of the Canadian Mining Institute* 7 (1904): 372-73.

11. *Debates*, 1901, Vol. II, 21 May 1901: 5723-24. Mackenzie Bowell's Conservative government had earlier enacted legislation to encourage silver-lead smelting in British Columbia: see *Debates*, 1895, Vol. II, 5 July 1895: 3925-28, and 18 July 1895: 4763-67.

it became clear that a solution to the industry's problems required far more than a cash payment for tonnage produced. Its economic difficulties were largely a function of a depressing geological reality.

As mining operations went deeper into the major properties around Rossland and the Slocan, the character of the ore changed, causing problems for mine managers, particularly in the latter. Zinc became a new and unwelcome component of that area's silver-lead ore. As the government official charged with overseeing the lead bounty explained, "More and more the situation as regards lead mining in British Columbia becomes involved with the question of the disposal of the zinc contents of the ores."[12] This difficulty was not unique to the mines of British Columbia; the major lead-producing regions of the United States and Australia had been grappling with it for nearly a decade.[13] The problem was the inability of traditional smelting methods to treat low-grade silver-lead-zinc ores efficiently: "In the furnace, zinc is the most volatile of metals, going off in vapour at a temperature lower than that necessary for the fluxing of the other contents of the ore. In its premature departure from the stack it forcibly carries off the silver and lead contents of the charge. Hence the presence of zinc in lead ores is penalized."[14] When the percentage of zinc rose above 10 per cent, smelters charged the producer fifty cents per ton for each additional percentage point.

"The zinc problem" which confronted the mining industry received its first public airing in 1904, when Alfred Garde, the manager of what had been one of British Columbia's most profitable mines, presented a paper on the topic to a meeting of the Canadian Mining Institute.[15] By that time, difficulties with zinc had closed many of the once-rich silver-lead mines of the Slocan, and a frantic search was underway for a method of treatment that would enable profitable operations to resume. Garde described how several properties were building concentrating plants to separate the zinc from the silver-lead ore, although none of these efforts ultimately provided a satisfactory solution to the zinc problem.[16] As the president of the Canadian Mining Institute commented in the discussion after the paper, "Zinc is one of the most refractory and nasty minerals in combination to treat."[17] If an adequate method of treatment could be implemented, however, zinc would quickly become a valuable asset instead of a crippling liability.

12. "Annual Report of Mr. G. O. Buchanan, Inspector of Lead Bounty Claims," Kaslo, B.C., 16 January 1914, printed in Canada. Parliament, House of Commons, *Sessional Papers*, 48:7 (1914) 11 (hereafter *Sessional Papers*). A petition by "The Zinc Producers of East and West Kootenay" provides an excellent account of the difficulties that mining companies faced as they encountered increasing amounts of zinc. See Canada. National Archives (NA), MG 26-G, Laurier Papers, Louis Pratt to William Templeman, Minister of Mines, 18 November 1909, Vol. 598, 162335-42.
13. For a succinct discussion, see Stephen H. Emmens, "The Treatment of Zinc-Lead Sulphides," in *The Mineral Industry Its Statistics, Technology and Trade 1892*, ed. Richard P. Rothwell (New York, 1892), 1:316-20.
14. "Annual Report of Mr. G. O. Buchanan...," 11-12.
15. Alfred C. Garde, "Notes on the British Columbia Zinc Problem," 368-76. On page 368, Garde claimed that "this treatise is the first one to appear in Canada on the subject."
16. See the *Report of the Commission Appointed to Investigate the Zinc Resources of British Columbia and the Conditions Affecting Their Exploitation* (Ottawa, 1906), 42.
17. In "Discussion" following Garde, "Notes on the British Columbia Zinc Problem," 375.

Europe was the acknowledged leader in zinc metallurgy. Commercial production of zinc had begun in the eighteenth century, but the metal had been mined and treated for centuries.[18] As early as 20 BC, for example, Romans were making brass (out of copper and zinc ore) in quantities sufficient to be used for their coinage. The standard European method for recovering the metal involved roasting zinc ore in retorts and then recovering the pure metal by distillation. Unfortunately, this regime, known as "the Belgian process," worked effectively only with relatively pure and high-grade zinc ores.[19] The low-grade ores common in North America and Australia, a mixture of silver, lead, and zinc, could not be treated by this method unless the silver and lead were removed prior to smelting. Despite this considerable difficulty, European investors backed an ambitious undertaking to erect a traditional zinc smelter in western Canada, intending to treat British Columbia's zinc ores.

At the time that Garde was identifying the zinc problem for the benefit of an audience in central Canada, Constant Fernau, a European mining engineer, was touring the Kootenays. In true entrepreneurial fashion, Fernau concluded that the zinc problem was, in fact, a promising business opportunity and, in 1904, he announced an ambitious and wide-ranging plan to treat the zinc ore of the province.[20] Fernau declared that he would build a concentrator for the ore, a zinc smelter, and possibly a lead smelter as well. Confident that this venture would represent "another advance in the great progressive strides [the country] is now making," Fernau happily predicted the best of all possible outcomes: "The general result will be increased profits for the mine-owner, increased traffic for the railways, the employment of a larger number of men, an increase in the output, and an addition to the general prosperity of this section."[21] Fernau wrote in a similar vein to Laurier, although his real motive appears to have been to secure a zinc bounty similar to that already in place for lead.[22]

Fernau was unable to secure government support for his project, but he did manage to obtain substantial European backing. The Canadian Metal Company Limited, with a million dollars in paid-up share capital, constructed a zinc smelter at Frank, Alberta, in the Crowsnest Pass, and purchased a silver-lead-zinc mine on Kootenay Lake.[23] Share registers indicate that the capital for this ambitious project was provided by some 470

18. For short accounts of the history of zinc treatment, see J. M. Dawkins, *Zinc and Spelter: Notes on the Early History of Zinc*... (Oxford, 1950), and E. J. Cocks and B. Walters, *A History of the Zinc Smelting Industry in Britain* (London, 1968).
19. For a description of zinc smelting by the Belgian process, see W. H. Dennis, *A Hundred Years of Metallurgy* (Chicago, 1964), 158-66.
20. "Zinc Plants for the Slocan," *The Daily Province*, 25 February 1904.
21. Ibid. See also "Reduction Plant," *The Daily Province*, 8 March 1904; "A Zinc Smelter," *The Daily Province*, 31 August 1904; "Zinc-Reducing Plant," *The Daily Province*, 14 September 1905.
22. NA, Laurier Papers, MG26-G, Vol. 297, 80465h-t, Fernau & Co. to Laurier, no date, but presumably early 1904, given its position in Laurier's correspondence files.
23. For the smelter plans, see *Report of the Commission Appointed to Investigate the Zinc Resources of British Columbia*... (Ottawa, 1906), 63-64. For a brief discussion of the mine which was to supply the ore, see W. Donald Fraser, "Historical Geography of the Riondel-Gray Creek Region 1882-1940," BA Essay (Geography), UBC, 1964, esp. 25-27, and Craig Weir, "Bluebell The Storybook Mine," *Western Miner & Oil Review* 33:5 (May 1960): 26-31.

French investors, a disparate group which included doctors, lawyers, clerics, and widows, most of whom invested the equivalent of a few hundred dollars.[24] The company's plan was to smelt zinc ore from British Columbia in a plant financed by French capital and fuelled by Alberta coal, relying on Belgian technology and employing American labour.[25] Built during the spring of 1905, reputedly at a cost of three hundred thousand dollars, the Frank plant produced its first zinc in early June of the following year.[26] Unfortunately for its backers, the smelter did not become the unqualified success that Fernau had predicted. A series of problems plagued the plant, its management seems to have been less than honest and, after operating for only a brief time, it was closed down.[27]

The failure of the Frank smelter did not discourage others from tackling the zinc problem. A group of mining men in the Kootenays, who seem to have enjoyed a particularly close relationship with successive governments, undertook the second major effort to treat the province's zinc ore. In 1905, these men persuaded the federal government to appoint a commission "to Investigate the Zinc Resources of British Columbia and the Conditions Affecting Their Exploitation."[28] The commission's report, which was mostly written by a leading authority on zinc, held little hope for treating the province's zinc ore by any known method.[29] Despite this gloomy prognosis, local mine

24. For a list of shareholders as of July 1906, see British Columbia Archives and Records Service [hereafter BCARS], Department of Attorney General, Registrar of Companies, Company Registration Files, 1897 series, Microfilm Roll 7, B 4422, GR 1438, Canadian Metal Company Limited, File #1195, pp. 51-61.

25. For a reference to the American labour used at the plant, see *A Record of the Investigation, Report and Subsequent Action of the Commission... To investigate the feasibility of Refining Copper and Producing Metallic Zinc on a Commercial Scale in the Dominion of Canada* (Ottawa, 1916), 206.

26. "Refining Zinc - First Spelter Made in Canada Turned Out by the Frank Smelter," *Victoria Daily Times*, 13 June 1906. The cost of three hundred thousand dollars is given in "Investigation of Processes for the Reduction of Refractory Zinc Ores," *Summary Report of the Mines Branch of the Department of Mines... 1910* (Ottawa, 1910), 12.

27. Early in 1906, Thomas Jones, manager of the smelter, had been found guilty, along with A. C. Garde, of cheating a Vancouver man on the value of some shipments; the judge described it as a "businesslike arrangement between two men to cheat a third." ("Court Roasted Zinc Buyers," *The Daily Province*, 22 February 1906.) In July 1906, the management of the company was changed considerably, presumably in response to problems with the smelter; see "Western News," *The Weekly Herald* (Calgary), 2 August 1906. For a dispassionate analysis of the smelter's failure, see *A Record of the Investigation, Report and Subsequent Action of the Commission...*, 187 and 206-07.

28. For an interesting account of the genesis of the commission, see "Zinc Mining in British Columbia," *Canadian Mining Journal* 31:9 (1 May 1910): 274.

29. The activities and findings of the 1905-06 Zinc Commission are amply discussed in its lengthy report, *Report of the Commission Appointed to Investigate the Zinc Resources of British Columbia and the Conditions Affecting Their Exploitation* (Ottawa, 1906). W. R. Ingalls was the person recruited to head the investigation. Then editor of the prestigious New-York-based publication, *The Engineering and Mining Journal*, he had earlier written two books on zinc metallurgy, *Production and Properties of Zinc...* (New York, 1902) and *The Metallurgy of Zinc and Cadmium* (New York, 1903). For evidence of Ingalls' lack of enthusiasm for zinc smelting in British Columbia, see *Report...*, 55, 72, and 133.

owners and business people decided to launch a company which would develop a means to smelt zinc using electricity, a process the report had specifically rejected as unsuitable to conditions in the province.[30] In 1905, the same year as the appointment of the commission, they formed the Canada Zinc Company Limited.

The most interesting aspect of this new company was the composition of its shareholders. Unlike the French backers of the Canadian Metal Company, this group was largely composed of experienced mining engineers and businessmen, most of whom lived in British Columbia and were familiar with the industry's problems.[31] Among the shareholders was the region's member of Parliament, W. A. Galliher. Each of the twenty shareholders made a substantial cash contribution: a single share represented an investment of one thousand dollars. The company appears to have possessed a degree of political influence, demonstrated by its ability to persuade the provincial government to advance a loan of ten thousand dollars during the 1908 session.[32] To achieve its goal of pioneering a commercial method of treating British Columbia's zinc ore, the company built an extensive plant, complete with a special electric smelting furnace, just one mile outside of Nelson. The design of this furnace incorporated a patented process acquired from Frederick Snyder, an American engineer and inventor, whose patents were the key asset of the company.[33]

Despite considerable investment in terms of money, time, and expertise, the Nelson plant of the Canada Zinc Company was not successful. The company ceased operations at the end of 1908, although its shareholders organized another appeal to Ottawa in the following year. In November of 1909, "the Zinc Producers of East and West Kootenay" requested further aid from the federal government.[34] Their petition, submitted to the

30. See, for example, *Report...*, 133. Electric smelting refers only to a specific type of furnace; it was a very different process from the subsequent electrolytic method of zinc treatment discussed below. One of Laurier's correspondents suggested that the Nelson business people's interest in electric smelting lay in their desire to find a market for the hydro-electric power being produced by their power plant: see NA, Laurier Papers, MG 26 - G, Vol. 604, 164136, E. O. Windsor to Laurier, 24 December 1909.

31. See BCARS, Department of Attorney General, Registrar of Companies, Company Registration Files, 1897 series, Microfilm Roll 7, B 4422, GR 1438, Canada Zinc Company, File #1249, p. 23. This is the list of shareholders as of 26 November 1907; nineteen men and one woman were then shareholders.

32. *BC Mines Annual Report*, 1907: 23.

33. The process is described by Frederick T. Snyder in "Electric Zinc Smelting," *The Canadian Mining Journal* 1:16 NS (November 1907): 492-93. For the patents, see No. 111,050, "Ore Treatment," *The Canadian Patent Office Record* 36:1 (March 1908): 731-32 and No. 111,673, "Process of and Apparatus for Treating Ores," *The Canadian Patent Office Record* 36:2 (May 1908): 1087-88. For a description of the Nelson operation, see "Plant of Canada Zinc Co. at Nelson," *BC Mines Annual Report*, 1908, 173-75.

34. See "Investigation of Processes for the Reduction of Refractory Zinc Ores," *Summary Report of the Mines Branch of the Department of Mines... 1910* (Ottawa, 1910), 11-15, where the petition of the zinc producers of East and West Kootenay to Templeman, the Minister of Mines, is reprinted. The date of the petition is given here as 7 April 1910. This is clearly a misprint; the date on the original petition is 18 November 1909. A copy survives in NA, Laurier Papers, MG 26 - G, Vol. 598, 162335-42.

Minister of Mines by a Canada Zinc Company shareholder, provided a lengthy narrative of the zinc problem in British Columbia, and claimed that the Canada Zinc Company had spent some $120,000 in its efforts to perfect electric smelting. This expenditure, the petitioners explained, had exhausted the financial resources of the company, and only government help (estimated at twenty to twenty-five thousand dollars) could bring the costly experiments to a successful conclusion. The Canada Zinc Company declared its willingness "to place their entire plant at the disposal of the officers of your Department and to render them every assistance in their power to complete the experiments and demonstrate the practicability of smelting the zinc-ores with electricity."[35]

The petition was referred to the federal Mines Branch for action, and the director suggested making a thorough investigation of the various trial processes for treating zinc before spending additional money on the Snyder process at Nelson. Parliament subsequently approved this course of action, and diverted for zinc research fifty thousand dollars from the funds set aside for the lead bounty.[36]

The subsequent government investigation of appropriate methods for treating the zinc ores of the province continued for some four years. Walter Ingalls, head of the 1906 Zinc Commission, once again contributed his expertise. Experiments were undertaken in laboratories at McGill University, as well as in Nelson, but Ingalls concluded in the spring of 1914 that further work would be unwise. In his view, a private company seemed close to perfecting an electric process and continuing the government research would simply be an unproductive duplication of effort.[37] The Nelson Board of Trade responded by requesting further government money so that a demonstration plant of the type to which Ingalls referred could be built at Trail, near Cominco's lead smelter,[38] but the outbreak of the First World War a few months later brought a halt to the experiments with electric furnaces.

The efforts to produce a commercial method of zinc treatment by means of electric smelting ended inconclusively, but another process was already being touted as the solution to the zinc problem in British Columbia's mining industry. This third attempt to unlock the secret of profitably treating the province's zinc ore was largely the work of one man, Andrew Gordon French. Originally from Scotland, French had worked as a metallurgist in Swansea, Wales and arrived in Victoria some time in 1909.[39] Descrip-

35. "Investigation of Processes for the Reduction of Refractory Zinc Ores," *Summary Report of the Mines Branch of the Department of Mines... 1910*, 12-13.
36. See ibid., 13-15 and *Debates*, Session 1909-10, Vol. III (21 March 1910): 5794-5801; also Vol. IV (30 March 1910): 5935-41.
37. See the report of Ingalls' speech in "Treatment of British Columbia Zinc Ores," *Canadian Mining Journal* 35:10 (15 May 1914): 334-36. Ingalls had earlier published two articles based on his research: "The Problem of Mixed Sulphide Ores," *Journal of the Canadian Mining Institute* 14 (1911): 479-86 and "The Electric Smelting of Zinc Ore," *Journal of the Canadian Mining Institute* 15 (1912): 101-14.
38. "Nelson Board of Trade Supports Proposal of Grant for Establishment of Demonstration Plant at Trail," *Canadian Mining Journal* 35:10 (15 May 1914): 336.
39. For brief discussions of French's background, see "Expert Will Study Ores in Kootenay," *The Daily Province*, 2 September 1910; "New Method for Smelting Zinc," *Victoria Daily*

tions of French differed markedly: to a senior official with Cominco (engaged in a lawsuit with French's company), he was "a rather clever and unscrupulous man... [who] apparently cribbed all his knowledge of zinc from the earlier patents and processes."[40] One of French's financial partners, however, assured Laurier in 1911 that he was "a gentleman of great scientific ability and well known among Mining Men throughout the world."[41] Several years later, the premier of British Columbia, in response to a direct question from Prime Minister Borden as to French's character, summed him up in one word: "eccentric."[42] French's expertise in the field of zinc metallurgy became a matter of considerable dispute, but he knew enough, certainly, to appreciate the importance and lucrative potential attached to the invention of a successful method of zinc treatment for the mining industry in British Columbia. Not long after his arrival, French announced that he had invented just such a process. He then persuaded a group of Victoria business people to organize a company to provide him with financial backing. This company, French's Complex Ore Reduction Company, received the patents that French obtained for his method of extracting zinc from British Columbia's refractory ores.[43]

In September of 1910, French announced his plans to relocate to Nelson, to perfect his method in a more convenient spot, closer to the Slocan mining district. With the cooperation of the business community there, French secured the city's abandoned powerhouse for his experiments. A year later, he successfully produced metallic zinc, using a process known by various names (the Létrange process, the wet extraction process, and the electrolytic process). This was a three-stage procedure, which involved roasting zinc ore, leaching it in solution, and then recovering the metallic zinc by electrolysis. Most metallurgists knew of the method, but regarded it as only theoretically feasible. It had been discredited in the 1890s when the efforts of a British company to establish it on a commercial basis ended in costly and well-publicized failure.[44]

Times, 22 September 1910; "The Zinc Problem," *The British Columbia Mining Record* 17: 3 (October 1911): 79-81; T. A. Rickard, "Electrolytic Zinc at Trail," *Mining and Scientific Press* 113 (30 December 1916): 933; and the flattering self- portrait in A. G. French to J. O. Patenaude, 8 August 1911, in NA, Laurier Papers, MG 26 - G, Vol. 689, 188710-14.

40. BCARS, Add. Mss. 2500, S. G. Blaylock to H. W. Gepp, 3 July 1924, Trail, Box 195.
41. NA, Laurier Papers, MG26-G, J. O. Patenaude to Laurier, 8 August 1911, Vol. 689, 188707.
42. NA, Borden Papers, MG26-H, Richard McBride to Robert Borden, 23 January 1915, Vol. 198, 110429, microfilm reel C-4392.
43. Share registers and other corporate records of this company may be found in BCARS, Department of Attorney General, Registrar of Companies, Company Registration Files, 1910 series, B 5118, GR 1526, French's Complex Ore Reduction Company Limited, File No. 40. The key patent was No. 140402, described in "Zinc and Manganese Production," *The Canadian Patent Office Record* 40:5 (May 1912): 1632.
44. This was the Sulphide Corporation's attempt to treat the refractory sulphide ores of Broken Hill at Cockle Creek, New South Wales, in 1897-98. Discussion of this initiative includes Edgar A. Ashcroft, "The Treatment of Broken Hill Sulphide Ores by Wet Extraction Processes, and the Electrolytic Deposition of Zinc," *Transactions of the Institution of Mining and Metallurgy* 6 (1898): 282-337; Walter Renton Ingalls, "Progress in the Metallurgy of Zinc," *The Mineral Industry Its Statistics, Technology and Trade* 6 (1898): 667-70; Ingalls, "The Treatment of Mixed Sulphide Ores," *The Mineral Industry Its Statistics, Technology and Trade* 7 (1899): 743-44; Ingalls, "The Ashcroft Process for the Treatment of Mixed Lead and Zinc Sulphide Ores," *Engineering and Mining Journal* 66 (22 October 1898): 488-90.

French's success with the process attracted much attention. The Provincial Mineralogist visited French's establishment in the autumn of 1911, and filed a thorough report in the annual report of the Minister of Mines.[45] In addition to the widespread public interest in his zinc experiments, French generated further excitement in Nelson when, in the Provincial Mineralogist's words, he "announced that he had discovered in certain dykes in the vicinity of Nelson... platinum... in considerable quantities, and that he had evolved a process by which they could be economically extracted. This statement might have been allowed to go unchallenged but for the great publicity given to the matter and its effect upon the District of Nelson."[46] The Department of Mines managed to obtain ore samples, and sent them as far away as New York and London to be assayed, in addition to having them tested by the Government Assayer in Victoria. The results were negative: no platinum bonanza could be expected.[47] This episode must have cast aspersions on French's character; the Mines department reports on the affair were certainly disapproving.

Cominco was more interested in French's claims concerning his ability to treat low-grade zinc ore than in questioning his integrity. In 1910, Cominco had acquired the Sullivan mine at Kimberley. This mine, with its massive ore deposit, had been in the hands of ASARCO, but the American company decided that its low-grade ore ("a complicated mixture of lead and zinc; too much zinc for a lead smelter and too much lead for a zinc smelter, under the primitive metallurgical processes known at that time")[48] was more trouble than it was worth. For its part, Cominco had purchased the Sullivan, not because it hoped to extract the zinc successfully, but simply to guarantee a ready supply of lead ore for its Trail smelter. Its own source – the St. Eugene mine at Moyie – was nearing depletion and the operation of the Trail smelter required a certain percentage of lead ore.[49] In this context, the French process appeared to promise a method of turning the marginally useful Sullivan ore into a highly lucrative product.

E. P. Mathewson, long-time manager of Anaconda, testified at a later patent trial that French's work was crucial ("the real key to the development of the art... the turning point"), finally persuading metallurgists to try the approach once more. See BCARS, Add. Mss. 25001, Cominco Papers, Electrolytic Zinc Process Company, Plaintiff, vs. French's Complex Ore Reduction Company of Canada, Ltd., Defendant. Vol. 5, p. 914. For a description of electrolytic refining, see Dennis, *A Hundred Years of Metallurgy*, 158-66.

45. Wm. Fleet Robertson, "French's Process For Separation of Zinc and Lead," *BC Mines Annual Report*, 1911: 162-65. Note also the brief descriptions in *BC Mines Annual Report*, 1910: 103, and *The British Columbia Mining Record* 17:3 (October 1911): 79-81.
46. "Reported Discovery of Platinum," *BC Mines Annual Report*, 1911: 165.
47. See *BC Mines Annual Report*, 1911: 165-70, and *BC Mines Annual Report*, 1912: 26 and 156-60.
48. BCARS, Add. Mss. 2500, Francis H. Brownell, president of Asarco, to T. A. Rickard, 8 July 1942, New York, copy on "Cominco Historical Microfilm." In a similar vein, J. V. Richards wrote that "The Sullivan mine... closed down, it is said finally, about the first of March..., ore getting too zinky. Everyone damns zinc, whereas it should be a valuable asset." "Smelting Zinc Electrically," *Mining and Scientific Press* 96 (18 April 1908): 519.
49. See the account of the Sullivan acquisition in J. M. Turnbull's "The Kimberley Story," *Western Miner & Oil Review* 36 (October 1963): 38-48. Turnbull was a mining engineer with Cominco at the time of the purchase.

In November of 1911, Cominco's general manager, R. H. Stewart, visited Nelson to meet with French. The two men discussed the applicability of French's process to the Sullivan ore, and Stewart returned in early spring of the following year with two other Cominco staff members. One of them stayed in Nelson for three months to study the process at first hand. Apparently, he filed a favourable report for, late in May of 1912, Cominco and French signed a contract giving the company exclusive rights to French's process. Once the process was fully operational, Cominco would pay French two hundred thousand dollars and a royalty on zinc production.[50] In addition, Cominco agreed to build a zinc plant, with a productive capacity of one ton per day, at Trail within twelve months. The company changed its plans several times, however, and the plant was not ready until May of 1914. French's son, Thomas, then moved to Trail to get the zinc plant in operation. Cominco, however, became increasingly dissatisfied with Thomas French's work and, in January of 1915, backed out of its contract with French's Complex Ore Reduction Company.

By this time, of course, the First World War had begun, and with war came new demands for base metals. The Canadian government realized early in 1915 that the country did not have refineries capable of producing either copper or zinc, the constituent metals of brass, which was used to make shell casings. Canada's munitions factories were forced to rely on refined copper and zinc from the United States to meet the contracts of the British War Office. Given wartime conditions generally, and the American desire to maintain a neutral stance in particular, this supply proved too vulnerable for government planners: "The uncertainty which existed in February, 1915, as to what action might be taken by the United States regarding the export of zinc and copper from that country to Canada and the necessity for taking no risks in the matter, led to the conclusion that it was desirable to investigate the feasibility of refining copper and producing metallic zinc in Canada."[51] A committee formed to investigate all aspects of the problem concluded that Cominco's smelter at Trail was probably best-situated to produce zinc and copper. The smelter was Canadian-owned, close to both ore supplies and hydro-electric power, and unencumbered by binding contracts; it also possessed an efficient research staff.[52] In June of 1915, the committee recommended to the federal cabinet that Cominco "be asked to enlarge their [experimental] plant to produce 25 tons of metallic zinc per day.... The amount of money for such extension to be advanced either by the Shell Committee or the Canadian Government."[53] The government was reluctant to make such outright capital advances, but apparently decided that wartime conditions justified the move.[54]

50. BCARS, Add. Mss. 2500, Plaintiff's Declaration, French's Complex Ore Reduction Company of Canada, Ltd., Plaintiff, vs. Consolidated Mining & Smelting Co. of Canada, Ltd., Defendant. No. 1804, Superior Court, Montreal, Quebec, June 1925; typescript copy held in File 1, Box 193 (hereafter "Plaintiff's Declaration").
51. *A Record of the Investigation, Report and Subsequent Action of the Commission...*, 1. Note also the comments of Alfred Stansfield, "Some Effects of the War on the Metallurgical Industries of Canada," *Transactions of the Canadian Mining Institute* 19 (1916): 134-36.
52. *1916 Zinc Commission*, 6-8, 273, and 278-80.
53. Ibid., p. 273.
54. For the government's misgivings, see the letter of Thomas White, Minister of Finance, to Carnegie, 7 July 1915 in ibid., 275-76. Blaylock described the agreement reached with the

Cominco had continued to experiment with zinc extraction processes after reneging on its contract with French, with the added incentives of sky-rocketing prices and high demand effected by the onset of the war. The company's metallurgists concluded that the basic stages that French had employed in his process – roasting, leaching, and electrolysis – did offer the best means of treating the Sullivan ore. Perfecting this process so as to guarantee large-scale commercial production was no easy matter, however, and the prospect of government money to construct a zinc refinery pledged to produce so many tons of zinc per day made some Cominco officials uneasy. They doubted that they had achieved adequate mastery of the process to make such a commitment. A letter from a senior official to the general manager expressed considerable diffidence about the prospects for success:

> it seems to me there is only about one chance in a hundred of our being able to make twenty tons of zinc a day at the end of six months....
>
> Excepting for the possible urgent need for zinc, a lot more work should be done before commencing operations on a large scale.... I don't think we ought to promise to produce any stated tonnage in any stated time.[55]

Cominco's board of directors ignored such misgivings: they were anxious that every effort be made to help in the war effort, and ordered a twenty-five ton zinc plant for Trail.[56]

Construction of Cominco's new zinc plant began in the autumn of 1915. When the mining journalist T. A. Rickard visited Trail in August 1916, the plant "had just started to produce."[57] Serious problems soon demanded attention, however, and it was only high zinc prices that allowed production to remain relatively profitable. Wartime conditions were temporary, and long-term success called for treatment of the Sullivan ore that would allow it to arrive at Trail in a purer state, as a higher-grade ore.[58] In fact, just such a method had been pioneered in Australia.

The development of flotation, a crucial advance in ore separation, had come a dozen years earlier in Broken Hill, New South Wales, the site of one of the world's largest silver-lead-zinc deposits. The new process baffled researchers, few of whom understood just why it worked, but there was no doubt about the results: hitherto intractable ores

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government in his speech at the Revelstoke mining conference, 11 July 1918, especially pp. 4-6; see also the remarks of J. J. Warren, managing director, in the Cominco *Annual Report* of 1916.

55. BCARS, Add. Mss. 2500, S. G. Blaylock to R. H. Stewart, 20 July 1915, Trail, Box 195.
56. This is clear, for example, in the letter of managing director James J. Warren to Sam Hughes, Minister of Militia, 15 June 1915, reprinted in *1916 Zinc Commission*, 267-68.
57. T. A. Rickard, "Electrolytic Refining at Trail," *Mining and Scientific Press* 113 (23 December 1916): 903. The zinc plant evidently started up in April 1916; see E. H. Hamilton, "Electrolytic Zinc Extraction at Trail, B.C.," *Transactions of the American Electrochemical Society* 32 (1917): 317-19.
58. For elaboration of this point, see R. W. Diamond, "The Development of the Treatment by Flotation of the Ore of the Sullivan Mine, Kimberley, B.C. 1917-1923," *Quarterly of the Colorado School of Mines* 56 (July 1961): 521.

could now be concentrated.[59] Following this Australian breakthrough, metallurgists around the world began to learn and apply the new process. The staff at Cominco was no exception. Flotation offered a solution to the problem of treating the Sullivan ore: it would permit the crude ore to be concentrated, that is, to be treated so that it became a relatively high-grade product before being shipped to Trail for further refining. In 1917, Selwyn Blaylock, Cominco's manager at Trail, persuaded R. W. Diamond, a Canadian with considerable experience in flotation then working for the Anaconda Copper Mining Company, to return to Canada to help Cominco find a way to mill the Sullivan ore. After a series of experiments, Diamond developed a process of selective flotation, capable of treating the mine's low-grade deposits.[60] These trials took some years, however, and the Sullivan concentrator at Kimberley did not begin operation until 24 August 1923. Having mastered the necessary technology, the company was now poised to exploit fully the massive reserves of Sullivan ore.[61]

By the First World War, a number of British Columbia's smaller mining companies resented Cominco's position as the leading smelter in the province. Many of these companies had either been directly involved in, or supportive of, the Canada Zinc Company and French's Complex Ore Reduction Company. They linked the need for government help in finding a solution to the zinc problem with their ability to compete with large corporations such as Cominco. This view is clearly evident in the response of the Vancouver Board of Trade to the federal government's decision in 1915 to help Cominco establish its zinc plant. The Mines Committee of the board wrote indignantly to the British Columbia premier, Richard McBride:

> The Trail Smelter Zinc works being erected is a private concern and will not smelt zinc ore from outside mines without a very large profit. This is exactly what is crushing the life out of the small mining companies that don't own a smelter. We consider it to be the duty of your Government to make arrangement [so] that the individual mines and companies, who have not the capital to erect a Smelting Plant of their own, [will be able to] get their ore treated at as low a rate as any of the Mining and Smelting Companies you have named treat their own ores.[62]

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59. One mining engineer noted that "the most peculiar fact about the flotation process of ore concentration is that in spite of its rapid development and wide application to metallurgy, the practical results obtained have not been built up as a result of the application of a definite theory, but have rather disregarded basic reasons and grown upon the practical physical facts derived from experimentation." Herbert A. Megraw, *The Flotation Process* (New York, 1916), 22. For an account of the development of flotation at Broken Hill, see Mouat, "Mining in the Settler Dominions," 214-21.

60. Diamond's article cited above provides a very good account of his research, but see also the jointly authored piece, "The Development of the Sullivan Mine and Processes for the Treatment of its Ores," *Transactions of the Canadian Institute of Mining and Metallurgy* 27 (1924): 306-69.

61. See the Appendix to this paper, illustrating the increasing importance of the Sullivan mine for Cominco in the postwar era.

62. Vancouver City Archives, Add. Mss. 300, Vancouver Board of Trade Papers, letter from Vancouver Board of Trade to Premier McBride (also Minister of Mines), 13 November 1915, copy in minutes of the board's Mines Committee, 1902-1917, Vol. 127, p. 51. For ease of reading I have deleted a number of eccentrically placed commas.

In the spring of 1917, the new Liberal government of the province enacted legislation "for the Establishment of Public Sampling and Concentrating Plants, Custom Smelters and Refineries," a move that was, in all likelihood, a response to such pressure. When the House of Commons discussed giving aid to Cominco in mid-1918, one member angrily charged the government with being "very anxious to create a monopoly." Cominco, he claimed, "formed a great monopoly in the province of British Columbia by reason of having this smelter, which is going to be supported by the Government.... The Consolidated Mining Company have [sic] put all the small miners out of business, and are now in possession, practically speaking, of the whole mining system of the Kootenay district."[63] That winter, a committee appointed by the federal government investigated the smelter rates charged by Cominco, although no legislation appears to have been introduced as a result.[64]

The Kootenay mining men continued their agitation for government intervention: in the autumn of 1919, for example, they lobbied long and hard for an experimental ore treatment plant in the Kootenays. A telegram to the Minister of Mines repeated a familiar litany, and referred to the growing breach between Cominco and the smaller operators. Cominco, explained the secretary of the Nelson Board of Trade,

> have for years been experimenting with the ore from their [sic] Sullivan Mine, expending several hundred thousand dollars towards that end.... It is self evident that whilst wealthy corporations... can afford to undertake the risk of making large expenditures in that direction, it is quite beyond the means of smaller concerns to do so.... Therefore the meeting was unanimous in claiming that it is the duty of the government to provide a suitable plant which will give the smaller concerns the necessary facilities for ascertaining the proper and most economical treatment for their complex ore.... Such a plant... would induce capital to the country and would do away with very much of the friction existing today between the shippers and the smelters.[65]

Letters and appeals for the experimental plant continued for three years, but nothing came of the initiative.

In the early 1920s, Cominco faced a legal challenge to its recent technological advantage, when French's Complex Ore Reduction Company of Canada launched a patent infringement suit against Cominco. French's company claimed that Cominco was using the patented French process, that as a result Cominco had become a very prosperous business, and that consequently Cominco should pay some eight million dollars in compensation.[66] The company asserted that French had invented the electrolytic process used by Cominco to treat its Sullivan ore, and that "the present action,... [was]

63. J. Read in *Debates*, Vol. 2, 23 May 1918, 2503.
64. NA, RG 45, Geological Survey of Canada Records, Vol. 51, File 3187, L. W. Humphrey to Chas. Camsell, 22 March 1923.
65. Ibid., Vol. 19, B.C. Ore Dressing Plant File #160, Vol. 1, telegram from Nelson Board of Trade to Martin Burrell, Minister of Mines, 7 October 1919.
66. "Plaintiff's Declaration." Andrew Gordon French had transferred his patents to French's Complex Ore Reduction Company in October 1912. This company evidently reorganized for, in August 1923, French's patents were transferred to French's Complex Ore Reduction Company of Canada, Ltd. The latter company was based in Montreal.

based on the infringement of . . . Patent [140402] by the Defendant."[67] French's company initiated legal proceedings in July of 1924, although the issue had been raised as early as 1917.[68] The court case was a rather quixotic affair in which Cominco emerged as the undisputed victor, but French's company was not without its supporters. As was the case with the mining operators of the Kootenays, French's company had been able to secure substantial support, particularly from the provincial government. A series of three legislative measures between 1916 and 1918, for example, advanced some sixty thousand dollars in loan guarantees to the company.[69] Both the French court case and the Kootenay lobby for an ore treatment plant were rearguard actions, however, and by the mid-1920s, control of the most profitable sector of the province's mining industry clearly lay with Cominco. Zinc producers now had little choice but to rely on its Trail smelter for ore treatment, and on terms that would favour Cominco.

ii

During the early-twentieth century, the mining industry in British Columbia had to adjust to the depletion of the high-grade ore bodies which had fuelled the 1890s boom. Many smaller mining companies found it difficult to alter their operations to accommodate this change. The former buoyant market had left a disastrous legacy of over-capitalization and numerous shareholders waiting impatiently for promised dividends. Such companies could not afford to undertake the kind of research and retooling that the new conditions made necessary. The creation of Cominco in 1906 is a good example of the consequences of this situation: the near-insolvency of several Rossland mining companies, unable to find a means of economically treating their lower-grade ores, provided the stimulus for the amalgamation.[70]

Although scholars in other parts of Canada, notably in the Maritimes, have for some time been engaged in sophisticated debates over economic development, few historians of British Columbia have made a serious attempt to understand the province's

67. Ibid., "Plaintiff's Answer to Plea," typescript dated 15 June 1925.
68. Early in 1917, for example, S. G. Blaylock (assistant general manager at Trail) wrote to Cominco's managing director, responding to "the statements that the operations of the Trail zinc plant have infringed on French's patents." BCARS, Add. Mss. 2500, Blaylock to J. J. Warren, 14 February 1917, Trail, Box 195.
69. "An Act to ratify an Agreement between His Majesty the King and French's Complex Ore Reduction Company, Limited" (1916); "An Act to amend the 'Complex Ore Process Aid Act'" (1917); "An Act to make Provision for Further Aid for the Purpose of developing a Process for the Treatment of Complex Ores" (1918). The provincial government's commitment to the French process comes out clearly in the minutes of the Vancouver Board of Trade's Mine Committee. McBride told the committee, for example, that "the French zinc process has been developed in British Columbia on British Columbia ores, by residents of the province, with their own money, of which they have expended a considerable amount, and have already achieved some measure of success. It is the endeavour of the government, so far as possible, to aid those who endeavour to help themselves." City of Vancouver Archives, Add. Mss. 300 Vol. 127, p. 45, letter of McBride to Committee, September 1915, copy in minutes of the board's Mines Committee, 1902-1917.
70. For a discussion of the legacy of the 1890s boom generally, and the amalgamation of Cominco in particular, see Mouat, "Mining in the Settler Dominions," 132-81.

corporate successes and failures.[71] Much of the historiography of British Columbia employs a whiggish analysis, concentrating on successful ventures and chronicling only the happy path which led ultimately to their various triumphs. Cominco's success, however, was neither inevitable nor preordained. The preceding narrative demonstrates that it was not shrewd business decisions, bold entrepreneurship, or an indomitable search for significant ore deposits that allowed the company to survive and prosper while other less ambitious or more timorous companies failed. Cominco was able to pioneer the necessary treatment process for zinc, and thereby guarantee its success, largely because of its size and the financial resources provided by its relationship with the CPR. As sometimes happens, luck also had a part in the eventual outcome: the war inflated the price of zinc, while the development of the flotation process in Australia furnished the necessary means to tailor the Sullivan ore to the electrolytic method. Although these two factors provided the catalyst for its success, neither are attributable to foresight on the part of Cominco management.

Cominco's development should not be seen solely in terms of the province's mining industry. After all, the emergence of large, vertically integrated companies dominating particular regions and industries was not unusual during this stage of the country's development. Quite the reverse is true: as Craig Heron states, "nothing figures more prominently in [the] early-twentieth-century transformation than the emergence of the large corporation as the driving force of the industrial capitalist economy in Canada."[72] Cominco was also controlled by the "tightly knit new national capitalist class based in Montreal and Toronto, with overlapping directorships," whom Heron sees leading a new and more-integrated national economy.[73] Business decisions with important consequences for the economy of British Columbia would be made by this group.

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71. The most interesting contribution to recent British Columbia literature is John Lutz's "Losing Steam: The Boiler and Engine Industry as an Index of British Columbia's Deindustrialization, 1880-1915," *Historical Papers/Communications historiques* (1988): 168-208; his voluminous footnotes provide a useful guide to earlier relevant work. The best introduction to the Maritime historiography is Eric Sager's review article, "Dependency, Underdevelopment, and the Economic History of the Atlantic Provinces," *Acadiensis* 17:1 (Autumn 1987): 117-37; see also the more recent article by Phillip J. Wood, " 'Barriers' to Capitalist Development in Maritime Canada, 1870-1930: A Comparative Perspective," *Canadian Papers in Business History* 1 (1989): 33-57.
72. Heron, "The Second Industrial Revolution in Canada, 1890-1930," 51.
73. Ibid., 52. A list of Cominco's first directors reveals the company's intimate association with the Canadian business elite: five of Cominco's first ten directors (Matthews, Osler, Hosmer, Buck, and Hodgson) figure in T. W. Acheson's list of 231 representatives of Canada's 1910 elite. Of the other five, two (Cronin and Aldridge) were ineligible, being Americans, and two more (Matthews, Jr. and Osler, Jr.) were children of the five listed. See Appendix, Thomas William Acheson, "The Social Origins of Canadian Industrialism: A Study in the Structure of Entrepreneurship," PhD diss., University of Toronto, 1971. The final director, English-born Montreal merchant George Sumner, receives scant mention in the various biographical compilations of the day, but his firm of Hodgson, Sumner and Co. was alleged to be "one of the most important in Canada" (*Gazette* [Montreal], 26 September 1921) and he was president of the Montreal Board of Trade in 1920. For an extended discussion of this group and its significance, see Mouat, "Mining in the Settler Dominions," 149-53.

Given the complex processes necessary to exploit low-grade deposits such as those at the Sullivan Mine, external ownership and control were probably unavoidable. Local ownership could never have matched the ability of Cominco to carry out research, to invest in new technology, and to utilize an extensive transportation/smelting/mining network – factors which facilitated the company's ultimate success. Whatever the likelihood of matching this achievement, however, Cominco's competitors also expended much effort and money in their attempts to unlock the metallurgical puzzle posed by the province's low-grade ores. The benefits that were thought to be a natural consequence of a prosperous resource sector justified such exertions; the central assumption was that the profits would be used to encourage secondary industries, deemed both more mature and more stable. Local entrepreneurs may have been unwise to attempt to compete with companies such as Cominco for control of the resource sector, but there is no reason to dismiss their larger objective – achieving economic diversification by reinvesting the profits of resource exploitation – as essentially unattainable. These hopes, of course, were not realized. Rather than being reinvested, the profits from Cominco's operations left the province in the form of dividend cheques. If judgements are to be made about this process, they should include some reference to the price that the province paid for entering the industrialized world of the twentieth century, in addition to noting its inevitability. The most significant cost was the loss of control.

The consequences of this loss are difficult to gauge, but a flurry of letters between Trail and Montreal in 1904 suggests that they were considerable. The manager of the Trail smelter, W. H. Aldridge, found it ludicrous that his plant shipped lead to central Canada, only to see it turned into pipe and subsequently returned to western Canada. He complained to Sir Thomas Shaughnessy, president of the Canadian Pacific Railway, that "the Eastern Manufacturers have invested a comparatively small amount of money in lead pipe machines, but have enjoyed immense profits through their operation." He proposed to go into competition and manufacture lead pipe in Trail. The response from Shaughnessy was understanding but firm:

> We must not lose sight of the fact that the men who are interested in this lead pipe business in the East are amongst the largest shippers over our line, and any advantage that you would receive from the utilization of your lead product in the manufacture of pipe would be a mere bagatelle as compared with the loss of revenue to the Company if these important interests were antagonized.... There is, as you say, a manifest incongruity in the fact that pig-lead is shipped from Trail to Montreal, then manufactured into pipe and shipped west again, but this occurs with a great many other articles.... I recognise your anxiety to make the most of the situation at Trail, but it is of vital importance that our other interests should not be overlooked.[74]

74. NA, MG 28 III 20, Shaughnessy Letterbooks 83, Thomas G. Shaughnessy to W. H. Aldridge, 12 October 1904, Reel 111, pp. 459-60. See also CPR Archives, Shaughnessy Letter Register #19 (1904), File 76913, Shaughnessy to Aldridge, 19 December 1904. The quotation in the text is from this latter source, W. H. Aldridge to Thomas G. Shaughnessy, 22 September 1904. This was two years prior to Cominco's formation but the smelter (owned by the CPR subsidiary, the Canadian Smelting Works) formed the basis of the new company, and Aldridge remained in control.

Additional policies adopted by the CPR – notably the inequities in freight rates – militated against the establishment of secondary industry in the province, let alone the most basic linkages from the resource sector.[75] The company sold its majority ownership in Cominco several years ago, having reaped profits for over half a century. Local ownership and control was finally achieved, since the consortium purchasing Cominco was dominated by the Vancouver-based Teck Corporation. The sale coincided with rumours that the Sullivan Mine was nearing depletion. In January of 1990, Cominco announced the mine's closure.[76]

75. On the CPR's policies, see Lutz, "Losing Steam," 182-85.
76. Discussions of the CPR sale of Cominco include Rod Nutt, "Teck group buys control of Cominco," *The Vancouver Sun*, 30 September 1986; Rod Nutt, "Deal puts Teck in major leagues," *The Vancouver Sun*, 1 October 1986; Rod Nutt, "Teck in charge at Cominco," *The Vancouver Sun*, 17 October 1986; John Twigg, "Norman Goes Bigtime - Teck Takes Cominco with a Longterm View," *Equity* 4:8 (November 1986): 19-28; and William Annett, "The Tecking of Cominco," *B.C. Business* 14:2 (December 1986): 24-31. For discussion of the announcement of the Sullivan's closure, see Karen Howlett, "Teck's tough-guy at Cominco not loved by all," *Globe and Mail* (Toronto), 19 February 1990.

Table 1
Mine Production, 1894-1937

	Short Tons Ore Rossland Mines	Short Tons Ore St. Eugene Mine	Short Tons Ore Sullivan Mine	Short Tons of Ore and Customs Concentrates treated at Kimberley and Trail Plants
1894 - 1905	761,417	313,416	—	910,973
1906	81,267	84,066	—	157,640
1907	81,788	127,645	85,406 (1900-07)	222,573
1908	175,799	155,419	—	305,956
1909	183,040	155,668	—	347,417
1910	194,013	114,136	6,704	487,125
1911	193,223	47,705	34,065	388,785
1912	209,427	13,460	21,189	296,458
1913	259,406	1,826	41,284	407,124
1914	232,878	1,217	30,919	374,771
1915	315,168	169	44,841	447,064
1916	309,720	746	91,129	447,017
1917	106,025	1,698	135,254	359,404
1918	106,374	1,191	104,758	374,889
1919	99,470	3,178	176,970	398,118
1920	54,644	938	259,814	592,763
1921	82,094	80	298,384	432,078
1922	18,566	—	360,844	407,260
1923	18,439	—	452,252	519,613
1924	157,504	—	996,260	1,133,523
1925	38,225	—	1,119,885	1,210,698
1926	25,317	—	1,115,387	1,354,821
1927	15,416	—	1,272,217	1,405,872
1928	13,886	—	1,571,931	1,665,586
1929	—	—	1,865,247	1,903,637
1930	—	—	1,924,017	1,947,004
1931	—	—	1,621,143	1,647,773
1932	—	—	1,447,448	1,473,663
1933	10,834	—	1,413,418	1,443,235
1934	39,397	—	1,748,331	1,792,298
1935	32,914	—	1,861,245	1,944,064
1936	9,329	—	1,898,099	1,945,882
1937	8,219	—	2,218,364	2,267,170

Source: *The Story of the Consolidated Mining and Smelting Company of Canada* (Trail, n.d.).

Figure 1
Production at Cominco Mines, 1906-1923

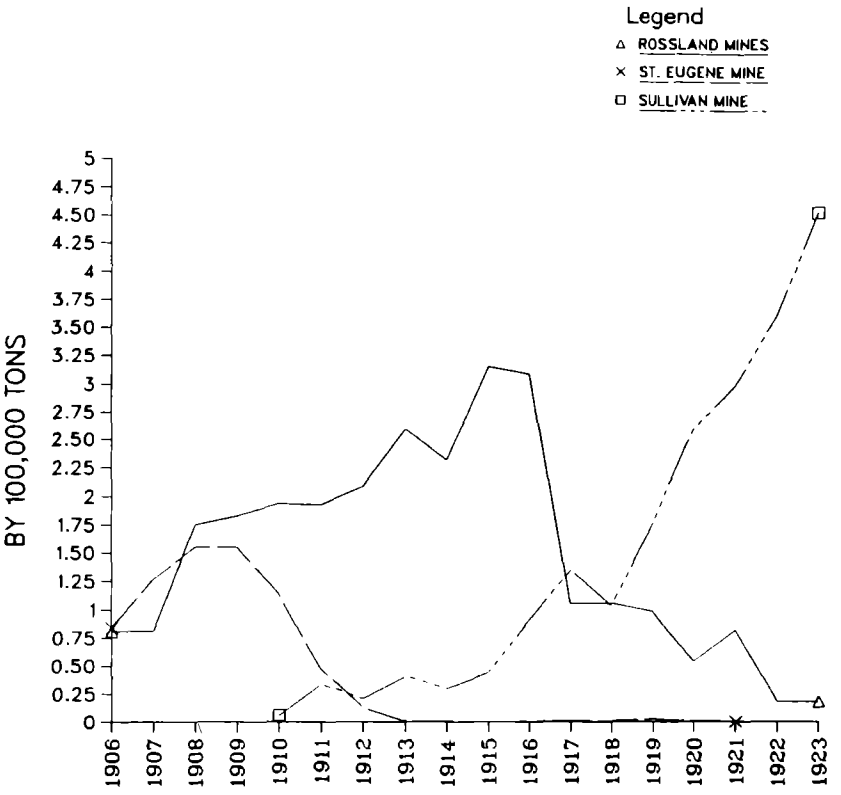
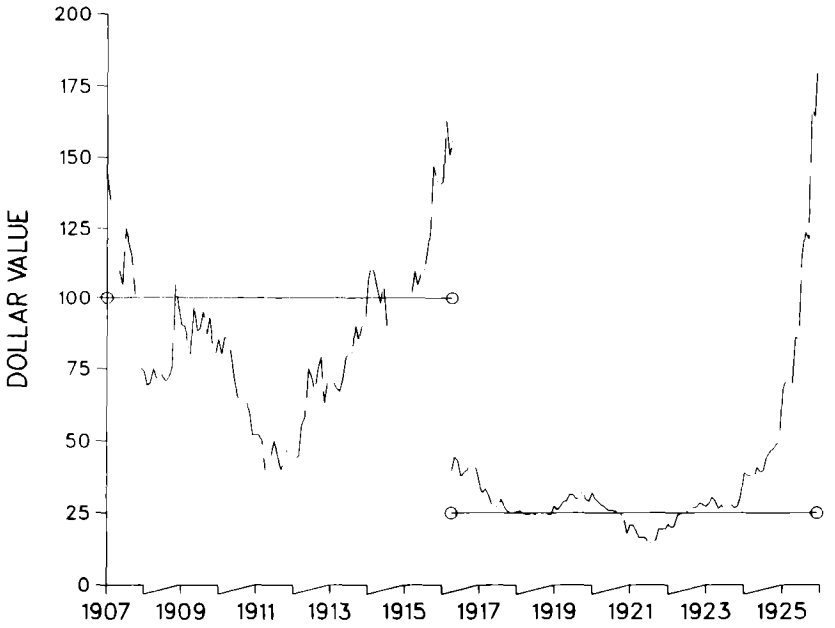


Figure 2
Cominco Share Prices, 1906-1925



Note: The line at one hundred dollars between 1907 and 1916, and at twenty-five dollars between 1916 and 1926, represents the par value of Cominco shares on the Toronto Stock Exchange.

Source: *Annual Financial Review*, 1915, 1921, and 1927.