Logging Railroads and Locomotives in British Columbia: A Background Summary and the Preservation Record

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Résumé/Abstract

Du début du siècle jusqu'au milieu des années cinquante, le chemin de fer a joué un rôle important dans l'ensemble de l'industrie forestière en Colombie-Britannique. Lorsque le transport ferroviaire du bois fut abandonné au profit du transport routier, de nombreux exemples de technologie ferroviaire furent préservés en Colombie-Britannique et certaines machines furent vendues ou données à des musées en Amérique du Nord.

Les plus imposantes des machines préservées sont certainement les locomotives de divers types. Le présent article expose les principales caractéristiques des chemins de fer qui desservaient l'industrie forestière en Colombie-Britannique, ainsi que les principaux types de locomotives utilisés. Un tableau présente le nombre de machines en service en Colombie-Britannique à cette époque, par fabricant, et recense toutes celles qui existent encore. Des remarques indiquent la provenance et la situation actuelle des 24 locomotives de Colombie-Britannique conservées en Amérique du Nord. Se fondant sur ce résumé, l'auteur traite de la valeur relative des divers spécimens en fonction des exposition des musées.

Logging railroads were a widespread and important component of the forest industry in British Columbia from the early 1900s until the mid-1950s. With the replacement of logging railroads by trucking systems, many examples of railroad technology were preserved in a variety of situations in British Columbia and some machines were sold or donated to museums in other parts of North America.

The largest and most prominent of the preserved artifacts are locomotives of a number of types. This paper presents an overview of the characteristics of British Columbia logging railroads and the principal types of locomotives used in logging service. A summary table outlines the number of machines used in British Columbia by manufacturer and then notes all surviving examples. Notes are provided on the provenance and current status of the twenty-four British Columbia locomotives presently preserved in North America. From this summary, the relative significance of the surviving machines for museum display is discussed.

Logging railroad systems were the most significant means of moving timber overland in British Columbia for at least the period 1900 to 1935 and were a highly important component of log transport systems until the mid-1950s.[1] By that time most logging railroads had been replaced by more flexible and capital-efficient trucking systems.[2] Fortunately, during the 1960s, nearly all steam locomotives surviving from logging service were preserved for exhibition or tourist railroad use in British Columbia and elsewhere in North America.[3]

These preserved locomotives represent the most striking artifacts of the steam logging era and are certainly among the largest. Because of their size and complexity they are also expensive to conserve and display. The purpose of this paper is threefold. Firstly, it provides an overview of the characteristics of logging railroads in British Columbia. Secondly, it focuses on the logging locomotives, considers the sources of supply (i.e., the manufacturers), describes their characteristics, and summarizes the use of each builder's products in British Columbia. Finally, a detailed tabulation summarizes the characteristics and provenance of individual, preserved locomotives from British Columbia operations in order to provide a basis for considerating their significance for museum display and long-term preservation.

I - The Characteristics of Logging Railroads in British Columbia

Logging railroads were built for one purpose – to transport timber from the areas where it was cut to a mill or to the nearest water body where the logs could be sorted and rafted to a mill for processing into lumber or related products.[4] Reliable operation was essential as large mills could not operate at maximum efficiency without a continuing source of logs.[5] The logging railroads were seldom built to carry general freight or passengers and as a result few were operated under government charter. Most were built as temporary systems designed to last only as long as the local timber supply. Consequently, they differed considerably in locational characteristics, construction standards, and equipment from mainline railways such as the Canadian Pacific or Canadian National or even the branch lines of these major railway companies.[6]

1. Locational and Operating Characteristics of the Lines[7]

Logging railroads generally were built from a fixed terminus such as a mill or log dump into the areas being logged. A line's purpose was to make the timber accessible to logging and to transport the logs at the minimum overall cost to the logging operation while maintaining a reliable timber supply for the mills.[8] In specific sites topography was a critical consideration in determining the most efficient plan for logging out a tract of timber and locating a railroad. Because the railroad was built to last for a limited time (i.e., until the timber was removed – which might be for as short a period as one month) and to minimize construction costs, however, curvature, gradients, and road bed could be engineered to lower standards than on mainline, common-carrier railroads.

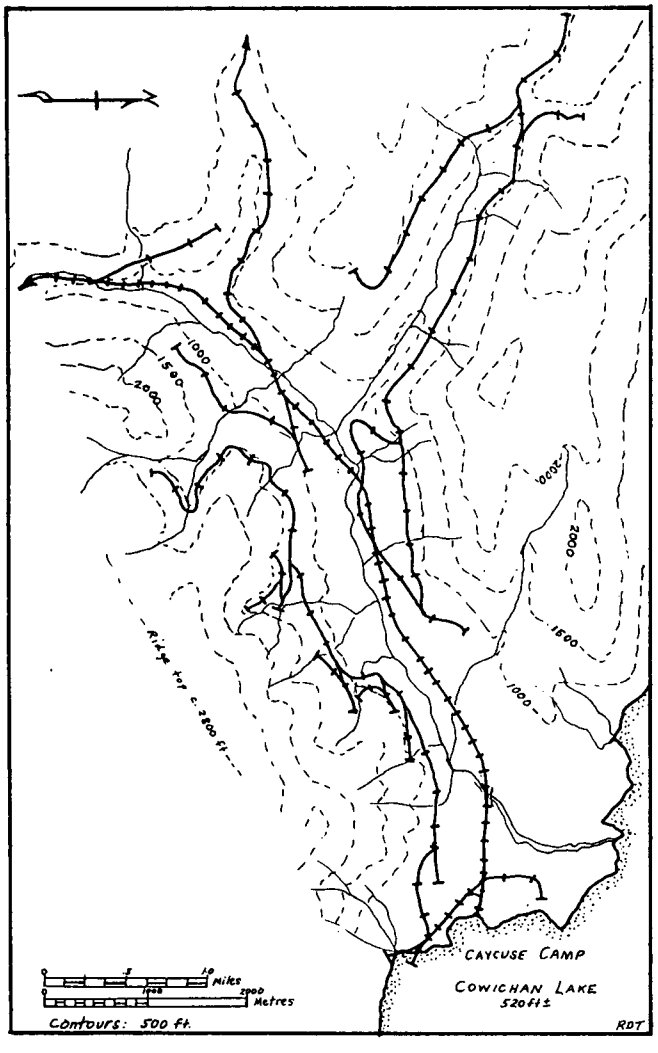

Fig. 1. Logging railroad track layout in mountainous terrain. Note the switchbacks, tight curves, and mainline through the valley bottom. (Redrawn from B.C., Department of Lands and Forests, Surveys and Mapping Service, 1:66,360 series, "Cowichan Lake," 1953.)

In general, in the rugged terrain typical of British Columbia, it was most common to enter a timbered area from the lower elevations and build the railroad upgrade into the areas being logged. This permitted hauling the logs down grade to the mills with consequently greater efficiency than hauling loads uphill would have permitted.[9]

The spacing of spur lines was generally determined by the distance yarding equipment could haul logs to the railroad and the obvious, site-specific limitations of topography. Yarding distances varied considerably with the type of equipment available. A small "donkey engine" could yard logs for perhaps only 150 metres while a more sophisticated system of skyline yarding normally could move logs 375 to 500 metres or on occasion as far as 1,075 metres.[10] In areas such as the Comox Valley on eastern Vancouver Island where there were no major topographic obstacles to logging, spurs were located approximately 350 to 750 metres apart in areas logged before the mid-1920s.[11] As logging progressed through an area, a complex network of temporary spur line trackage developed (see fig. 1). Usually the spur line tracks were removed and the rails re-laid elsewhere as soon as the merchantable timber was removed from the site.[12]

As timber cutting became further removed from the terminal sites a semi-permanent mainline often was developed. Such lines usually ran up the valley bottoms with spur lines radiating into the timbered tributary valleys. Typical patterns of logging railroad location are depicted in figures 1 and 2. Features of track design such as switchbacks and reverse curves to overcome particularly steep topography are noted.

2. Track Construction

Nearly all British Columbia logging railroads were built to standard gauge: 4 feet, 8½ inches (1.43 metres).[13] This gauge was adopted to facilitate interchange with the branch lines of the major railway systems and also for safety reasons as standard gauge provided greater stability than three-foot gauge or metre gauge used for railroads in other parts of the world. All but three steam-powered operations are known to have used steel rail for track construction.[14] In two of the exceptions, operation was on wooden poles in place of rails but both lasted only a short time.[15] The capacity of pole railroads or simply "pole roads" was too limited and the system too makeshift to provide reliable, cost-effective operation. The third atypical operation used cut four-inch-by-four-inch timbers in place of rail.[16] The weight of steel rail used varied from forty pounds per yard on small operations to seventy pounds on the major systems.

In general, the longer a line was to be in place and the more timber to be hauled, the greater the expenditure that could be justified on railroad construction.[17] However, a

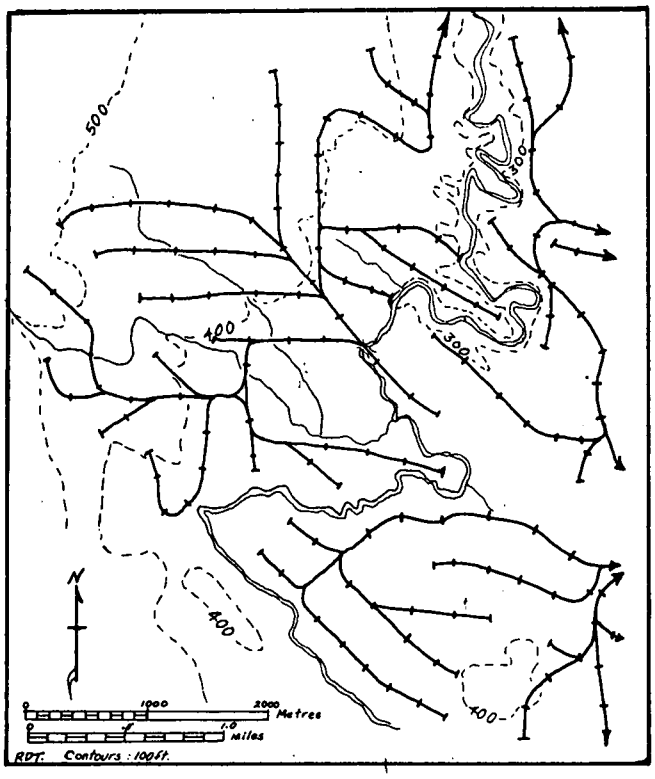

Fig. 2. Logging railroad track layout in flat terrain. Note the even spacing of the trackage and efficient track arrangement. (Redrawn from B.C., Department of Lands and Forests, Surveys and Mapping Branch, 1:50,000 series, "Oyster River" 92F/14W, 1957.)

company's existing equipment could dictate minimum standards of construction for a particular section of railway where expediency might suggest lower standards. For example, a large locomotive already on the roster of a company would require a heavy weight of rail and sturdy bridges regardless of whether the timber in a small area would have justified that standard of construction. Projected service life of the rail line also influenced the choice of construction materials and line location priorities. If timber were limited, large expenses to relocate a line to eliminate an adverse grade could not normally be justified.[18] On the other hand, an extensive stand of good timber could warrant expensive, high quality railroad construction since the costs could be ammortized over a long period of time.

The maximum grade normally considered acceptable on a major railroad system such as the Canadian Pacific Railway is 2.2 per cent, but on logging lines much steeper gradients were used to reduce construction costs in areas of rough terrain. On spur lines grades of five or six per cent were common while on logging mainlines two- or three-per cent grades were typical.[19] In extreme circumstances grades over ten per cent might be constructed when lines were to be in place for a short period – perhaps only a month or two. Steep grades reduced the pulling power of locomotives and also created problems of train control. Stopping a heavily loaded train on a ten-per cent down grade was difficult and required an experienced crew. Such considerations made locomotive maintenance, the use of air brakes, and track maintenance standards particularly important for safety reasons.[20]

3. Outline of geographic distribution of logging railroads in British Columbia

The main concentrations of logging railroads in British Columbia were on Vancouver Island, in the Fraser Valley, along the south-west coast of mainland British Columbia, and in the Kootenays in the south-east part of the province.[21] Isolated operations were located on the Queen Charlotte Islands[22] and at scattered points throughout the southern half of the province. The greatest activity was on Vancouver Island and the logging railroads were active there for the longest period of time.[23] Table 1 summarizes the number of operations in each of the geographic regions noted above.

TABLE 1

Logging Railroads in British Columbia by Region

	1906	1924	1945	1964
Vancouver Island	12	41	21	3
Fraser Valley	6	12	-	-
Mainland Coast	1	17	-	-
Kootenays	7	5	-	-
Other	2	1	1	-

Source: *The Timberman: Directory of the Forest Industry, 1906, 1924* (Portland, Oreg.) and B.C., Department of Railways, *Annual Reports, 1945, 1964* (Victoria, B.C.).

The reasons for the differing application of logging railroads in these regions of British Columbia are beyond the scope of this discussion but the following relevant considerations should be noted. The smaller species logged in the southern interior, particularly pine and interior Douglas fir, were more easily moved by trucks and horses than the larger coastal species. In addition, water transport on lakes and rivers such as the Arrow and Kootenay Lakes system was in some instances more feasible than in the areas logged on the coast. Moreover, the topography of many parts of the interior limited the application of railroad technology; only in the large, flat, valley bottoms around Cranbrook and Fernie was it really feasible to use logging railroads extensively. The Fraser Valley and surrounding foothills were logged in part to clear land for agricultural purposes and timber stands were depleted quickly. The

supply simply was more limited. On Vancouver Island timber stands were of high quality and closest to major milling and shipping points so logging these areas was economically advantageous. Consequently the best timber was logged first and the remoter stands on the mainland coast were not exploited as rapidly due to their inaccessibility and consequent higher production and transport costs. Topographic conditions also favoured development on Vancouver Island, particularly on the relatively flat coastal plain on the eastern side of the island.

In general after 1930 logging railroads were almost exclusively a component of coastal logging operations, most particularly those on Vancouver Island. This is reflected as well in the numbers and the provenance and history of preserved locomotives in British Columbia as noted in part III below.

4. Trends in Operation

Summary tabulations and notations in the early logging industry directories and government departmental reports indicate that the logging railroads in British Columbia began as simple operations, seldom more than a few miles in length.[24] By the 1920s a number of larger operations had developed using several locomotives and 30 to 50 kilometres of track at any one time. Examples of these larger operations would include the railroads of Comox Logging and Railway Company and of International Timber Company, both on Vancouver Island. As an illustration of the extent of operations in British Columbia during the 1920s, in 1924 74 logging railroads were in operation, using 1,129 kilometres of track and 125 locomotives.

The average length of railroad was 15.25 kilometres. Further examination of the operations is revealing. Of the total, 44 operations had only 1 locomotive and each had an average of 6.4 kilometres of track while 15 had 2 locomotives and an average of 15.6 kilometres of track. In sum over 70 per cent of the operations were in this size range and probably these were the operations most readily converted to trucks. Most appear to have been independent operators or small partnerships.[25] While the efficiency of the small operations cannot have been great, presumably it was more cost-effective than other means, such as horse logging or trucks, available at that time. It is clear, however, that only modest advances were required in trucking technology before a conversion to trucks was justified. The balance probably swung in the early to mid-1930s (see table 1), but the details of this transition need further clarification. Also significant was the gradual improvement in public road systems which greatly decreased the costs of truck logging.[26]

The Depression and the Second World War contributed to the retention of logging railroads due to the capital costs of replacement systems such as trucks during the period of low income in the 1930s and the unavailability of new equipment because of wartime production limitations. Moreover, during this period large quantities of used railroad equipment were available at reduced prices.[27] Nonetheless, the number of rail lines decreased significantly by the mid-1940s (see table 1) as trucking became increasingly important. In fact, very few new locomotives were built for the logging industry in North America after 1930. The last delivery of a new steam locomotive to a British Columbia logging firm was made in 1940 after a lapse of four years and in total only three were purchased new after 1930.[28] The industry continued on for several decades using the equipment at hand or available on the used market.

The railroads remained an important part of the larger coastal logging operations until the early 1950s when modernization programmes began. By 1956 the number of rail operations had been reduced to only 6 although 427.33 kilometres of track were in use, for an average length of 71.23 kilometres.[29] This was an increase in average length over 1924 of nearly 470 per cent, reflecting the trend toward larger operations with longer timber hauls.

The 1950s were a time of corporate consolidation in the forest industry marked by the formation of the present large forest companies such as British Columbia Forest Products and MacMillan Bloedel. Many smaller operations were amalgamated and at the same time the log hauling systems were largely taken over by trucks. By 1960 only three logging railroads were operating in British Columbia; the remainder had been scrapped.[30]

The reasons for the conversion to trucking can be quickly summarized. Firstly, the valley lands where railroads could be built economically were mostly logged off and the costs of rail line construction and operation on the steeper hillsides were excessive. Larger trucks with improved brakes and with greater capacity than vehicles of the pre-Second World War years were available and could be used on roads built at a much lower cost than a railroad. In general, trucking systems were more flexible and required less capital to operate because they did not need a fixed railroad to run on. Depending on the circumstances, particularly the relative length of haul, there were also savings in labour. By the late 1940s it was noted that "motor truck installation and operating costs are lower than railroads and therefore, have been widely introduced and successfully used."[31] In a few situations, however, where haulage distances were great, railroads could still be competitive and it was under these circumstances that a few logging railroads survived. They operated in conjunction with trucks which acted as feeders to the railroad. In effect the trucks replaced the spur line railroad operations. On

the surviving railroads, unit trains of logs were run from centralized reloading sites. Trucks brought the logs from where they were cut to terminal sorting grounds and from there the logs were trans-shipped by rail to the mills. By the 1970s only two such rail opertions remained, one used by Canadian Forest Products on northern Vancouver Island and the other by Crown Zellerbach Canada on southern Vancouver Island. Both railroads, still operational, are fully dieselized, with modern equipment.[32]

In summary, the logging railroads were temporary, one-commodity operations, built to move timber from the cutting areas to the mills. They operated in rough terrain which often required steeply graded track with sharp curvature. Often the trackage was in place for only a short time and the standards of construction were lower than on major railway systems. Efficient, low-cost operation dictated these characteristics. However, logging railroads of this type were only possible by the availability of specialized technology – locomotives and to a much lesser degree rolling stock* – that could be employed effectively under these severe service conditions

II - Logging Railroad Locomotives Used in British Columbia

1. Types of Locomotives

The locomotive was by far the most costly and significant piece of equipment used on the logging railroads. There were two basic types of logging locomotive – rod locomotives and geared locomotives – and four major manufacturers supplying locomotives to the specialized market in North America.[33] The rod locomotive was essentially the same type of machine used on the mainline railroad systems, but modified to be better suited to logging conditions.[34] In these machines the driving wheels were mounted in a rigid or sometimes articulated frame be-

* The characteristics of logging railroad rolling stock are outlined briefly in the appendix.

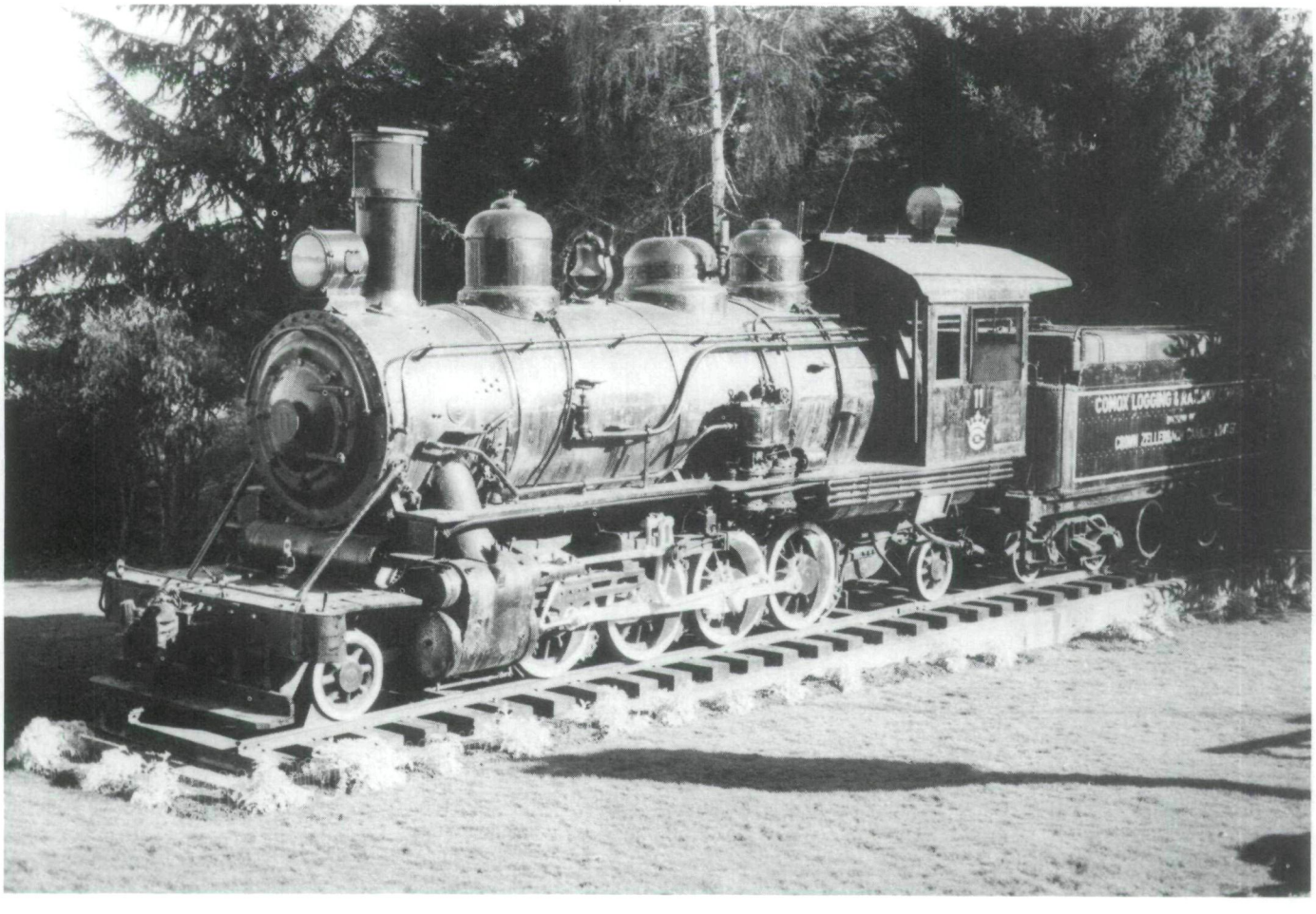

Fig. 3. A representative tender-equipped rod locomotive. This is Baldwin 57409 (Crown Zellerbach-Comox Logging and Railway Company No. 11), a 2-8-2 type. (Photo: British Columbia Provincial Museum, [BCPM] uncatalogued.)

TABLE 2

Logging Locomotives Used in British Columbia by Type and Manufacturer to 1981

Type/ Manufacturer	Estimated Number Used	Percentage of total (to nearest 1%)	Ranking by Manufacturer According to Number Used in B.C.	Number Preserved in B.C.	Number Preserved Elsewhere	Total Type Preserved	Percentage of Total Preserved
A. *Geared*							
Shay	82	39	1	6	3	9	39
Climax	53	25	2	2	1	3	13
Heisler	17	8	4	-	-		
Williamette	1	less than 1%	10	-	-		
Washington	[1][a]	less than 1%	10	-	-		
(Sub-total)	(154)	(74)					(52)
B. *Rod*							
Baldwin	18	9	3	6	-	6	26
Old Baldwin[b]	1	less than 1%	10	-			
American (Alco)	1	less than 1%	10	1	-	1	4
Montreal (MLW)	5	2	6	1	-	1	4
Canadian (CLC)	4	2	7	-	-		
Porter	5	2	6	1	-	1	4
Davenport	3	1	8				
Other	3	1	8	1	-	1	4
Old Mainline[c]	6	3	5	1	-	1	4
(Sub-Total)	(46)	(22)					(48)
C. *Diesel*[d]							
General Motors[e]	4	2	7	-	-	-	-
Montreal (Alco)	2	1	9	-	-	-	-
Baldwin	1	less than 1%	10	-	-	-	-
Other[f]	2	1	9	-	-	-	-
(Sub-total)	(9)	(4)					
D. *Home-built*[g]	3	2	7	-	-	-	-
(Sub-total)	(4)	(2)					
TOTAL	213			19	4	23	

NOTES: This table was compiled from a variety of sources including Michael Koch, *The Shay Locomotive, Titan of the Timber* (Denver, Colo.: World Press, 1971); Thomas T. Taber and Walter Casler, *Climax: An Unusual Locomotive* (Morristown, N.J.: Railroadians of America, 1960); Dan Ranger, Jr., *Pacific Coast Shay* (San Marino, Calif.: Golden West Books, 1964); Provincial Archives of British Columbia, Department of Railways files (RG 817); archival photo documentation from various repositories; on-site examination of all machines surviving since 1962 by the author. Roster information has been circulated by Elwood White, "Roster of Vancouver Island Logging Locomotives," mimeographed (Victoria, B.C.: published by the author, 1958) and the periodical *Steam Chest* (1958-64). Additionally, rosters and builder's lists have also been compiled by members of the Railway and Locomotive Historical Society, Washington, D.C. Since the information is still fragmentary, totals may vary as more data become available.

a Unconfirmed.

b One Baldwin, ca. 1883, 0-6-0 T, originally used in coal mining, was used briefly in logging service on Vancouver Island by Frank Beban at Haslam Creek.

c Old locomotives, most of uncertain origin, used in logging service. These included one 2-8-0 while the rest were 4-4-0 types.

d All but two diesels used in B.C. are still operational in 1981. Small gas-mechanical locomotives such as Porters, Whitcombs, and Fordsons are not included; they probably numbered about fifteen.

e Includes both Canadian (General Motors Diesel) and American (Electro-Motive Division) plants.

f Two geared steam locomotives (one Shay and one Climax) were scrapped and the mechanisms used to produce diesel locomotives used by Canadian Forest Products. These are included in geared locomotive tabulations as well.

g Various primitive machines built using donkey engines or small steam engines.

neath the boiler and the wheels were connected to the cylinders by driving rods. Adaptations for logging service normally included the addition of pilot and trailing wheels to improve safe operation in both directions (turning facilities were seldom available on logging lines) and of small-diameter driving wheels to increase tractive effort or pulling power. A typical example of a rod locomotive is shown in figure 3. Some machines were equipped with side or saddle tanks. These normally carried extra water for the boiler. Carrying the water in this way added to the weight on the locomotive's driving wheels and hence increased traction. Rod locomotives used on British Columbia logging railroads varied in size from small, 10-ton, 0-6-0 types to articulated 2-6-6-2 machines exceeding 150 tons in weight.[35] The most typical wheel arrangements were the 2-6-2 and 2-8-2 types. The dominant manufacturer of this type of logging locomotive in North America appears to have been the Baldwin Locomotive Works[36] in Philadelphia, Pennsylvania, whose products were used on a number of logging railroads in British Columbia (see table 2). Other less significant manufacturers of rod locomotives were the H.K. Porter Company of Pittsburg, Pennsylvania, American Locomotive Company (Alco) of Schenectady, New York, Montreal Locomotive Works (MLW) of Montreal, Canadian Locomotive Company (CLC) of Kingston, Ontario, and Davenport Locomotive Company of Davenport, Iowa.

The second basic type of logging locomotive was the geared engine.[37] Several differing designs were developed for the logging industry in the United States and were used in British Columbia. The geared locomotive was designed particularly to operate on steep grades and around sharp curves. In consequence, these locomotives were well adapted to conditions in British Columbia. The principle of all designs was to have the power from the locomotive's cylinders transmitted to the driving wheels by a system of gears and articulated drive shafts which produced low speed but high power operation in much the same manner as an automobile permanently in low gear.

The driving wheels were mounted in two axle trucks which could move independently instead of in a semi-rigid frame as used on rod locomotives. As a result, these were highly adaptable to typical logging railroad trackage. Whereas the rigid wheel base of a typical rod locomotive might be 4.27 metres, the rigid wheel base of a geared locomotive might be only 1.32 metres. As a result, the latter could operate on curves of much tighter radius. The performance and other characteristics of a Baldwin rod locomotive and a comparable geared locomotive, a Shay, are shown in table 3. The ability of the geared locomotive to perform better than the rod engine on steep grades is readily apparent from this comparison.

TABLE 3

Comparison of Characteristics of Shay Geared and Baldwin Rod Locomotives

	Shay Locomotive (3-truck, Pacific Coast type)	Baldwin Locomotive (2-6-6-2, Mallet type)
Total weight	181,000 lbs.	320,000 lbs.
Weight on drivers	181,000 lbs.	182,000 lbs.
Dead weights (tender and weight on pilot and trailing wheels)	none	138,000 lbs.
Average weight per pair of drivers	30,060 lbs.	30,330 lbs.
Rated tractive power	38,200 lbs.	38,200 lbs.
Drawbar pull on grades		
1% grade	35,670 lbs.	31,000 lbs.
3% grade	32,050 lbs.	24,600 lbs.
6% grade	26,600 lbs.	15,000 lbs.
Total wheel base	41' 2"	68' 0"
Rigid driving wheel base	4' 4"	8' 4"
Lightest rail advised	45 lbs. per yd.	50 lbs. per yd.

NOTE: Based on information in Lima Locomotive Works 1927 catalogue reproduced in Dan Ranger, Jr., *Pacific Coast Shay* (San Marino, Calif.: Golden West Books, 1964), p.56.

There were three principal types of geared locomotives used in North America. These were the Shay, built by the Lima Locomotive Works of Lima, Ohio, the Climax, built by the Climax Manufacturing Company of Corry, Pennsylvania, and the Heisler, built by the Heisler Company of Erie, Pennsylvania.[38] While all were similar, there were important differences in design. The Shay was developed first, being built in quantity by the 1880s. In typical form, it featured a boiler offset to the left side of the locomotive frame with two, or most commonly three, vertically mounted cylinders driving an articulated crank shaft running along the right side of the locomotive. Shays ranged in size from 2-truck machines of less than 10 tons to 3- and 4-truck locomotives exceeding 150 tons. Over 2,700 were built before production ceased in 1945. Locomotives in the 50- to 90-ton range were most common.[39] A typical Shay is shown in figure 4.

The typical Climax differed in having its boiler centered on the longitudinal axis of the locomotive and having one cylinder on each side. The cylinders drove, through a gear box, an articulated drive shaft running under the boiler. The shaft was geared to each axle of each truck under the locomotive. A representative Climax is depicted in figure 5. Climax ranked second to Shay in the total number manufactured. Between 1,030 and 1,060 were produced before the plant closed in 1928.[40]

The Heisler also had two cylinders and a centrally mounted boiler but its cylinders were arranged in a V pattern, forming a cradle-like configuration under the boiler. The drive shaft was geared to only one axle of each truck with power to the other being transmitted by conventional driving rods.[41]

Shay, Heisler, and Climax locomotives were all developed for the same market and were all competitive. Each incorporated new technology in the basic design as developments took place. However, consideration had to be given to ease of maintenance and rugged design as few logging railroads had extensive maintenance facilities.[42] The most advanced examples of the geared locomotives were developed in the 1920s for the west coast logging railroads. The most advanced, mass-produced Shay was called the "Pacific Coast" Shay, while the Heisler equivalent was the "West Coast Special." Climax did not specially name its product but it had equivalent features. These were modern locomotives for the period, featuring piston valves, girder frames, superheaters, and other advances found in mainline railroad locomotives. However, the Depression effectively ended orders for new logging locomotives and only the Pacific Coast Shay was produced in quantity. It is notable that of a total of twenty-four Pacific Coast Shays built between 1927, when the design was introduced, and 1940, when production ceased, seventeen operated in British Columbia. The design clearly was considered a success by operators.[43] In contrast, only one West Coast Special Heisler and two or three equivalent Climax locomotives were used in the province.

Fig. 4. A representative Shay locomotive. This machine is Lima No. 3311, a typical, modern two-truck Class B Shay. Preserved at Ladysmith, B.C., by Crown Zellerbach Canada. (Photo: BCPM, uncatalogued.)

2. Comparison of the Use of Different Logging Locomotives in British Columbia

The four major manufacturers – Baldwin, Lima, Climax, and Heisler – all successfully marketed their locomotives in British Columbia. Table 2 provides a summary of new and second-hand locomotives, by builder and type, operated in the province. Note that locomotives of other manufacturers were also used but in limited numbers. A ranking of the different manufacturers clearly establishes Lima's Shay locomotive as the most commonly used machine with thirty-nine per cent of the total number of logging locomotives used. Climax ranks second with twenty-five per cent, Baldwin rod locomotives are third at nine per cent, and Heisler fourth at eight per cent. Other manufacturers' contribution to the total roster of logging locomotives is minor.

Perhaps of greatest significance is the cumulative total of Shay, Heisler, and Climax products (154 machines) which account for 74 per cent of all logging locomotives in the province. Clearly, geared locomotives were the dominant form of motive power on the logging railroads in British Columbia and competition was not between geared locomotives and rod locomotives but rather among the different types of geared engines. The comparative ratio between the different types used corresponds approximately with total sales of the three types throughout North America.[44]

The other noteworthy category in this tabulation is "Old Mainline." These machines ranked fifth in usage in

the province. Most were obsolete locomotives acquired from railroads such as the Northern Pacific, Canadian Pacific, and Pennsylvania, and used in logging service with very little modification. Five of six identified were of the 4-4-0 or "American Standard" wheel arrangement.[45] Locomotives of this type would have been poorly adapted to logging service due to their large driving wheels and were used, as far as can be determined, only in the early years of the industry and in areas of relatively flat terrain.

In-service comparisons between the different types of locomotives to determine which was best in logging service are now impossible and it appears that few, if any, comparisons were made in earlier years under operational conditions.[46] Documentary evidence also appears to be lacking and in the absence of such information it is reasonable to assume from the sales figures that overall the Shay was the best machine for conditions found on the west coast. The Shay was a powerful and comparatively smooth-riding machine that was easily serviced due to the accessible arrangement of its drive train. The Climax and Heisler were generally conceded to be more difficult to service and the Climax was a rough riding locomotive, hard on the crews.[47]

The availability of different types of locomotives gave logging railroad operators considerable choice and flexibility in acquiring equipment to develop efficient log-hauling systems. Small scale operations typically had one or two geared locomotives in the fifty-ton range which could be used in most situations. Larger opertions could afford to specialize and might purchase a rod locomotive for mainline hauling over the more permanent sections of railroad where this type of machine's greater speed was advantageous. Normally these larger systems then employed geared locomotives on the spur lines to feed carloads of logs to the mainline.[48] In the 1950s when trucks were used increasingly to replace the spur lines of the logging railroads, the geared locomotives were retired first as they were not as well suited to line haul situations because of their characteristic low speed. This evolution is significant both for historical interest and also because it helped determine the types of locomotives that would be preserved in the 1960s.

It is also evident from table 2 that the use of diesel locomotives on the logging railroads has been very limited. In total, the nine known units represent only four per cent of the total of logging locomotives used in the province.

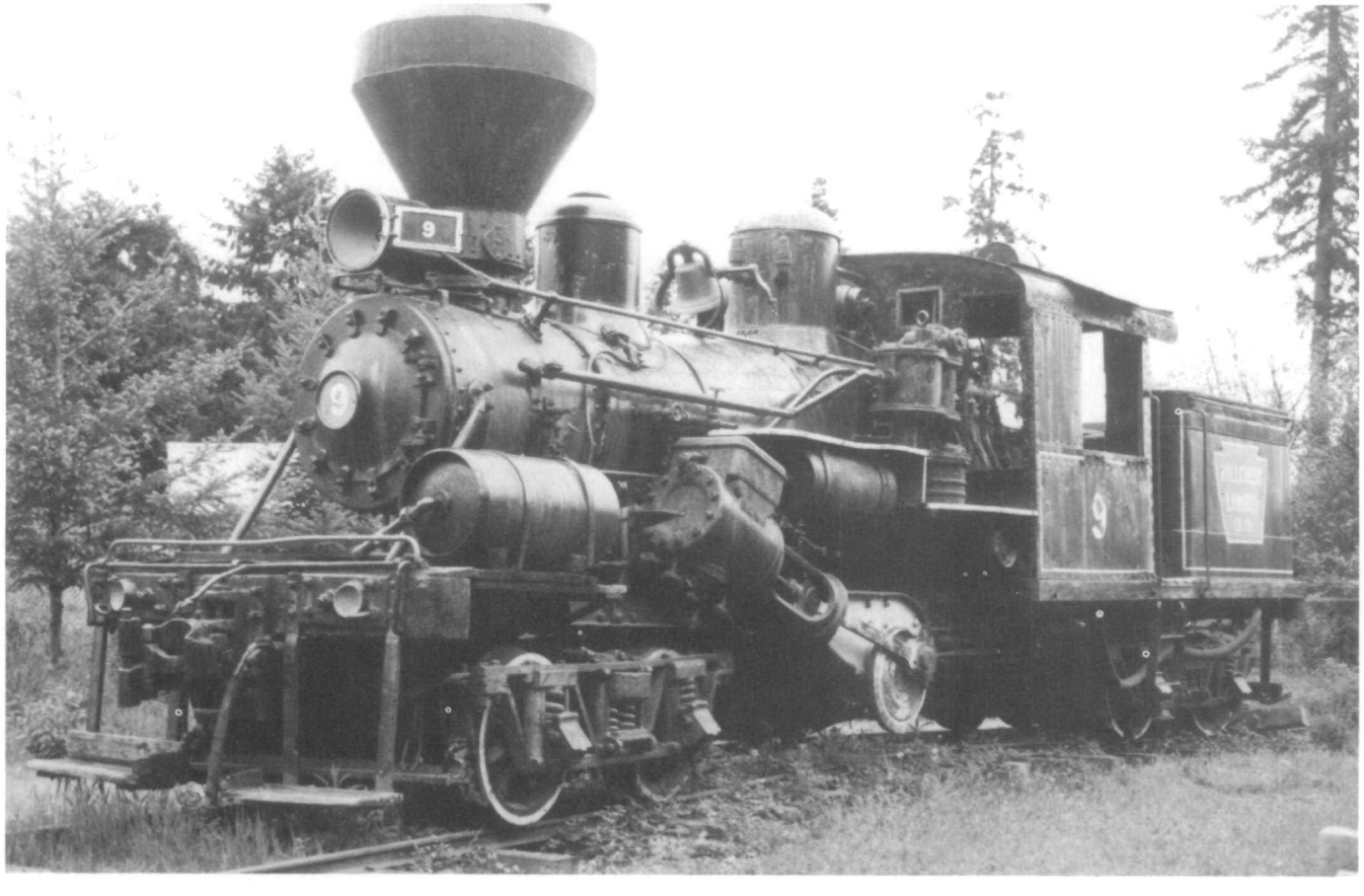

Fig. 5. Climax No. 1359 is a typical two-truck Class B machine. It is the only fully intact Climax preserved in British Columbia. Hillcrest No. 9 is on exhibit at the British Columbia Forest Museum at Duncan, B.C. (Photo: BCPM, uncatalogued.)

Only two operations acquired diesels and both companies continue to operate logging railroads in 1981.[49] Other companies scrapped their railroad operations entirely rather than acquire new diesel power for their established systems.[50] The cost-effectiveness of dieselization would have depended on a number of considerations including the cost of maintenance of the rest of the railroad's physical plant, the location and value of timber, the length of haul, and the costs of acquiring and operating additional trucks.

The limited number of Canadian-built locomotives used in British Columbia is also noteworthy. No geared locomotives, other than home-built ones, were manufactured in Canada for use in British Columbia. Of rod locomotives, only nine of forty-six were Canadian-built. The reason for this lack of sales from Canadian manufacturers awaits further study but a significant factor may have been the relatively small Canadian market for logging locomotives compared to the large market in the western United States. American builders were probably able to develop specialized designs at lower cost for the logging railroads. To illustrate, in 1928 there were 352 rod locomotives and 880 geared locomotives operating in eight western states and British Columbia. Of these, only 24 rod and 113 geared locomotives were used in British Columbia.[51] Since the geared locomotives were built to patented designs and there was little need for more variations of the concept, the remaining market was small indeed. Most of the Canadian products can be described as small industrial locomotives that could have been used in a variety of industrial situations rather than under specialized logging conditions. Why Shays were not built in Canada under licence is unclear but again the market may have been too small to justify the cost of setting up the facilities for production at a time when Lima itself was not always working at capacity.[52] Probably there was no real advantage to the company.

III - Preserved British Columbia Logging Locomotives

As noted in table 2, 24 British Columbia logging locomotives survive out of a total of approximately 213 operated in the province. Of the 24, 21 are still in British Columbia and all have been dedicated to some form of public or private preservation. All other steam locomotives have been scrapped or are beyond salvage. Table 4 provides a detailed summary of all the surviving steam locomotives from British Columbia logging service, noting their principal characteristics and details of ownership.

The Shay locomotive, which comprised nearly forty per cent of all British Columbia logging locomotives, is well represented with nine machines preserved, six within the province itself, although, when individual machines are examined, there is considerable duplication. Preserved Shays represent thirty-eight per cent of all preserved logging locomotives in the province so the number preserved corresponds closely to the number originally in use. Table 5 records, by builder's number, the surviving Shays, grouped to define essentially identical machines.

TABLE 4

Preserved British Columbia Logging Locomotives

	Shop Number	Date	Type	Cylinders/Drivers (in inches)	History/Provenance[a]	Status[b]
I. Geared Locomotives						
A. Shay Locomotives (Lima Locomotive Works)	2305	9 May 1910	2T	8x8/27.5	-24 tons -East Kootenay Logging Co., No. 3, Cranbrook, B.C. -Polson Logging Co., No. 3, Hoquium, Wash. -Rayonier Inc., No. 3, Hoquium, Wash. -placed on display near Hoquium, Wash.	1
	2475	15 Sept. 1911	2T	10x12/29.5	-42 tons -Bloedel Stewart & Welch, No. 1, Myrtle Point, B.C. -Great Central Sawmills, No. 1, Great Central, B.C. -Bloedel Stewart & Welch, No. 1, Great Central, B.C. -MacMillan Bloedel, No. 1, 1951 -Gerald Wellburn, private display 1953[c]	

				-on display at British Columbia Forest Museum, Duncan, B.C.	1
2548	28 June 1912	2T	10x12/29.5	-42 tons -Weist Logging, No. 1, Port Alberni, B.C. -Alberni Pacific Lumber Company, No. 2, Port Alberni, B.C. -MacMillan Bloedel, Port Alberni, B.C. -placed on display in Alberni, B.C.	4
3147	13 Dec. 1920	2T	8x8/29	-25 tons -Hillcrest Lumber Co., No. 1, Cowichan Lake, B.C. -Export Lumber Co., No. 1, Dec. 1934 -Mayo Lumber Co., No. 1, (purchased for re-sale, not use), Paldi, B.C. -Osborn Bay Wharf Co., No. 1, Crofton, B.C., Mar. 1947 -British Columbia Forest Museum (Cowichan Valley Railway, No. 1) Duncan, B.C., 1964; modified to operate on 3-foot gauge museum railway.	2
3262	22 Apr. 1924	2T	11x12/32	-50 tons -Mayo Lumber Co., No. 3, Paldi, B.C. -British Columbia Forest Museum Duncan, B.C., 1967; on display (locomotive previously on display by Mayo at Paldi, B.C.)	1
3289	1 Oct. 1925	2T	11x12/32	-50 tons -Merrill & Ring Lumber Co., No. 4, Theodosia Arm, B.C. -Comox Logging & Railway Co., No. 15, Headquarters, B.C., later Ladysmith, B.C. -Elk Falls Co., No. 1, Duncan Bay, B.C. -National Museum of Science and Technology, Ottawa, for exhibit, 1975	4
3311	29 June 1927	2T	11x12/32	-50 tons -Merrill & Ring Lumber Co., No. 2, Squamish, B.C. -Comox Logging & Railway Co., No. 12, Ladysmith, B.C., May 1942; placed on permanent exhibit at Ladysmith, June 1962.	1
3320	26 July 1928	3T	13x15/36	-Pacific Coast, 90 tons -built for stock -Mayo Lumber Co., No. 4, Paldi, B.C. -Lake Logging Co., No. 5, Honeymoon Bay, B.C., Feb. 1943 -Western Forest Industries, No. 5, Honeymoon Bay, B.C., Dec. 1946 -Railway Appliance Research Ltd., No. 114, North Vancouver, B.C., Jan. 1964	

					-Cass Scenic Railway, No. 114, Cass, West Va., 2 Oct. 1970, operated on museum/tourist railroad	2
	3350	4 Apr. 1940	3T	13x15/36	-Pacific Coast, 90 tons -Merrill, Ring & Wilson Ltd., No. 5, Rock Bay, B.C. -Mayo Lumber Co., (purchased for re-sale, not use), Paldi, B.C. -Hillcrest Lumber Co., No. 5, Mesachie Lake, B.C., 1945 -Canadian Forest Products Ltd., No. 11, later No. 115, Englewood, B.C., 1953 -Railway Appliance Research Ltd., No. 115, North Vancouver, B.C., Feb. 1962 -Fort Steele Historic Park, No. 115, Fort Steele, B.C., 1970; operated on tourist railroad.	2
B. Climax (Climax Manufacturing Company)	1057	1910	2T	9x12/28[d]	-23 tons -Shawnigan Lake Lumber, No. 2, Shawnigan Lake, B.C. -Saltham Lumber Co. -Channel Logging Co., No. 2, abandoned ca. 1930 -salvaged by G. Taylor, 1971 -British Columbia Provincial Museum Victoria, B.C. 1974; used as exhibit on Museum Train, 1975-79. -British Columbia Forest Museum Duncan, B.C., on display, 1980	1
	1359	June 1915	2T	12½x14/33	-50 tons -M.D. Olds, No. 1, Birch, Michigan -Alberta Lumber -McNair Logging -Canadian Robert Dollar Co. -Abernathy Lougheed Logging, No. 44, Haney, B.C. -Hillcrest Lumber, No. 2, later No, 9, Mesachie Lake, B.C. -British Columbia Forest Museum, Duncan, B.C. for display, 1964.	1
	1693	Mar. 1928	3T	14½x16/35	-70 tons -Hillcrest Lumber, No. 3, later No. 10, Mesachie Lake, B.C. -Victoria Pacific Railway, No. 10, Victoria, B.C. (not operated) -sent for tourist railroad use near Tacoma, Wash., 1980 -operational by July 1981.	4

	Shop Number	Date	Type	Cylinders/Drivers (in inches)	History/Provenance[a]	Status[b]
II. Rod Locomotives						
A. Baldwin (Baldwin Locomotive Works)	34270	Feb. 1910	2-6-2T (with tender)	16x24/44	-Howe Sound Pemberton Valley & Northern, No. 2, Squamish, B.C. -Howe Sound & Northern No. 2, Squamish, B.C. -Pacific Great Eastern, No. 2, Squamish, B.C. -Comox Logging & Railway Co., No. 7, Headquarters, B.C., 1920 -to Pacific Great Eastern, Squamish, B.C. for display, 1965.	3
	34921	July 1910	2-6-2T	15x22/44	-Comox Logging & Railway, No. 2, Headquarters, B.C. -on display, Courtenay, B.C., ca. 1960.	1
	56323	1923	2-6-2T	x/44	-Snoqualmie Falls Lumber Co., No. 6, Snoqualmie, Wash. -Canadian Forest Products, Beaver Cove, B.C. -on display, Beaver Cove, B.C., late 1970	1
	57409	Nov. 1923	2-8-2	18x24/44	-Donovan Corkery Lumber Co., No. 4, U.S.A. -Comox Logging & Railway Co., No. 11, Headquarters, B.C. -on display, Ladysmith, B.C., 1962	1
	58687	Sept. 1925	2-8-2T	18x24/44	-Bloedel Stewart & Welch, No. 4, Bloedel, B.C. -MacMillan & Bleodel, No. 4, 1951 later No. 1066, Chemainus, B.C., ca. 1952 -on display, Squamish, B.C., 1978.	1
	60942	Aug. 1929	2-8-2T	18x24/44	-Campbell River Timber Co., No. 2, Campbell River, B.C. -Alberni Pacific Lumber Co., No. 7, Port Alberni, B.C. -MacMillan & Bloedel Ltd., No. 1007, 1951 (leased to Comox Logging & Railway Co. as No. 18) re-numbered 1055, 1961 -to B.C. government, 1975, stored.	3
	61159	Dec. 1929	2-8-2	18x24/44	-Charles R. McCormick Lumber, No. 101, U.S.A. -Comox Logging & Railway, No. 16, Headquarters, B.C. later Ladysmith, B.C. -West Coast Railfan Assoc., later West Coast Railway Assoc., No. 16, Vancouver, B.C., 1964 (later leased to Victoria Pacific Railway as tourist operation, 1971-80 -operated on Alaska Railroad on excursions, 1967	1

B. Old Baldwin	2660	1872	4-4-0	15x24/57	-Northern Pacific, No. 56, -Joseph Whitehead, "Countess of Dufferin", 1887 -Canadian Pacific Railway, No. 151, 1882 -Columbia River Lumber Co., No. 1, Golden, B.C., 1891 -City of Winnipeg for display, "Countess of Dufferin", 1910	3
C. Porter (H.K. Porter Company)	6877	May 1924	2-6-2T	17x24/44	-Timberland Development Co., No. 4, Ladysmith, B.C. -Victoria Lumber & Manufacturing Co., No. 4, later No. 1044, Chemainus, B.C. -MacMillan Bloedel, No. 1044, Chemainus, B.C. 1951 -on display Chemainus, B.C., 1970.	1
D. Montreal Locomotive Works	65337	Dec. 1923	2-6-2	17x24/44	-Cathels & Sorenson, No. 1, Port Renfrew, B.C. -Victoria Lumber & Manufacturing Co., No. 7, later No. 1077, Chemainus and Ladysmith, B.C. -MacMillan & Bloedel, No. 1077, Ladysmith, B.C., 1951 -British Columbia Provincial Museum, Victoria, B.C. 1975.	2
E. Alco (American Locomotive Company)	61859	1920	2-8-2	x/44	-Portland Astoria & Pacific -Alberni Pacific Lumber Co., No. 6, Port Alberni, B.C. -H.R. MacMillan Co., No. 1055 -MacMillan & Bloedel, No. 1055, Chemainus, B.C., 1951 -Canadian Forest Products, No. 55, later No. 113, Woss Camp, B.C. -on display at Woss Camp, B.C., 1976.	1
F. Marschuetts & Cantrell	Unknown	1879	0-4-4T built as 0-4-0T	14x20/42	-contractor's locomotive, used to build San Francisco sea wall -Andrew Onderdonk for construction of Canadian Pacific Railway "Emory" 1881 -sold to Royal City Planing Mill Co., (later B.C. Mill Timber and Trading Co.), 1887; used in various B.C. lumber camps and retired in 1927 -on display at Hastings Park, Vancouver, B.C., 1931 -moved to Heritage Village, Burnaby, B.C., 1973 -known for many years as "Old Curly"	1/4

NOTES: Sources include field observations by the author of all machines noted; oral tradition; photographic evidence; sources noted for table 2; construction records of the locomotive builders published in Michael Koch, *The Shay Locomotive, Titan of the Timber* (Denver, Colo.: World Press, 1971), Thomas T. Taber and Walter Casler, *Climax: An Unusual Locomotive* (Morristown, N.J.: Railroadians of America, 1960), and Omer S. Lavallée and Robert R. Brown, *Locomotives of the Canadian Pacific Railway Company,* Railway and Locomotive Historical Society Bulletin no. 83 (Boston, Mass., 1951).

a. History/Provenance lists the location, ownership, and/or use of each locomotive in chronological sequence, from the earliest to the most recent period. Specific dates are given where these are known. "No" refers to the company's road number, i.e., the number assigned to the locomotive.

b. Status numbers are defined as follows: 1 - on exhibit outside with minimal maintenance, unfenced in nearly all cases; 2 - in operational condition; 3 - housed inside and in secure storage; 4 - being reconstructed to operational condition.

c. Dimensions are for the 25-ton model.

d. Mr. Wellburn founded the British Columbia Forest Museum at Duncan, B.C. in 1964 after privately collecting many significant logging artifacts. His approach was to select key pieces representing different eras and technologies and was certainly the most systematic attempt at large industrial preservation in the province.

TABLE 5

Preserved British Columbia Shay Locomotives by Type

Type	Builder's Number	Display Location
2T, Class B (Older Style)	2305	Hoquiam, Wash.
	2475	British Columbia Forest Museum, Duncan, B.C.
	2548	Port Alberni Museum, Port Alberni, B.C.
	3147	British Columbia Forest Museum, Duncan, B.C.
2T, Class B (Modern)	3262	British Columbia Forest Museum, Duncan, B.C.
	3289	National Museum of Science and Technology, Ottawa, Ont.
	3311	Crown Zellerbach, Ladysmith, B.C.
3T, Pacific Coast	3320	Cass Scenic Railway, Cass, W. Va.
	3350	Fort Steele Historic Park, Fort Steele, B.C.

There is some variation in size and construction detail within the older style Class B Shays and, similarly, within the modern Class B Shays, but in technological terms the machines are essentially similar and represent the same stages of Shay development. The two Pacific Coast Shays are identical. Before definitive conclusions could be drawn regarding the representativeness or uniqueness of each machine, a detailed study of all the Shays used would be required. However, it is clear from preliminary surveys that the preserved Shays are essentially representative of the typical machines used in British Columbia. It is safe to say that from a national perspective Lima's 3289, preserved at the National Museum of Science and Technology is an entirely appropriate example of a west coast logging locomotive. Overall, the Shay has been well-represented and three or four of the surviving machines are in operational condition. Parenthetically, while operation may not represent the purest form of artifact conservation, in a practical sense it has seemed to ensure greater care being given to the machines. All locomotives on static exhibit have suffered considerably from weather and vandalism.

Three Climax locomotives from British Columbia have been preserved but of these only one is essentially complete and preserved in Canada. For many years engine 1057 now at the British Columbia Forest Museum, was abandoned in the forest and many parts were removed or damaged. Only the boiler, frame, and part of the drive train are original. Consequently its value as a representative machine is diminished. Engine 1693 is now in Washington State and after a decade of neglect has undergone reconstruction for tourist railroad use. The British Columbia Forest Museum's other Climax, 1359, a representative two-truck, Class B machine, is the only known intact Climax locomotive in Canada.[53] Since Climaxes were the second most common type of logging locomotive in the province, the value of this machine as an artifact is most significant and its conservation should be a priority. No Heislers or examples of other geared locomotives were preserved so these gaps must remain in historical collections. The omission of a Heisler from the list of preserved British Columbia locomotives is sad indeed for it was the fourth most common type of locomotive in the province.

Private efforts were made to save the last Heisler, but by the time the would-be purchaser was aware of the machine's availability it had already been sold for scrap.[54]

Rod locomotives, most notably Baldwins, have been preserved in some quantity. In total, rod locomotives represent nearly one-half the total number of preserved locomotives yet only twenty-two per cent of logging locomotives in the province were of this type. This high proportion of preserved locomotives was due, as noted, to the fact that as trucks progressively took over from the railroads, it was the geared locomotives that were scrapped first. They had been used in the steep spur lines which were the most expensive to operate. Rod locomotives, normally used on the longer mainline logging railroads, were retained because, on the established lines, they were cost-effective to operate.[55] Of the twelve rod locomotives preserved, ten came from the last three operating logging railroads (i.e., four from MacMillan Bloedel, four from Crown Zellerbach, and two from Canadian Forest Products). These three companies had retained the locomotives until the 1960s or 1970s when historical interest had become sufficient to ensure their preservation in some form.

The remaining two preserved rod locomotives – the Baldwin 2660 in Winnipeg and the Marschuetts and Cantrell "Old Curly" in Burnaby – were preserved well before any of the other machines because of their connection with the construction of the Canadian Pacific Railway rather than their representativeness as logging locomotives. However, the significance of "Old Curly" as a logging locomotive is also great because it is typical of perhaps twelve to fifteen small rod locomotives used in the province in the period 1890-1920. It is the only survivor of this particular type of small tank locomotive used on the more technologically primitive lines.[56]

While the range of equipment, defined by size, builder, and wheel arrangement, represented by these twelve rod locomotives is great, for all but the two Canadian Pacific Railway locomotives a simple grouping is possible. There are basically two types preserved: tank engines and tender-equipped engines. Of the former, six are preserved, of the latter, four. Consequently, there is considerable duplication in the types preserved. As with the geared locomotives there is great variation in the state of preservation of these machines. Only one is operational (Montreal 65337) and it was superficially altered for service on the British Columbia Museum Train. Only Baldwin 60942 is stored under cover in fully intact condition.[57] It was moved into storage after being retired from service by MacMillan Bloedel in 1973. All the other rod locomotives are on outside exhibit, exposed to the weather and vandals. Alco 61859 is undoubtedly the best maintained of this group due to the remoteness of its display location on northern Vancouver Island and the interest that Canadian Forest Products staff have taken in the machine. However, the majority of preserved locomotives on static outdoor exhibit receive only cursory maintenance and deteriorate rapidly to what might best be termed hulk condition with all small or breakable parts missing.[58]

The record of logging locomotive preservation in British Columbia has been significant with twenty-four preserved machines representing a number of types. However, because of the essentially random and unco-ordinated nature of the preservation attempts, there is considerable duplication, some significant gaps – notably the lack of any Heislers – and some poorly represented types. Since the record cannot be re-written, gaps filled, or oversights corrected, the relative significance of the different types of locomotives can suggest priorities for conservation and restoration efforts. Specifically, the British Columbia Forest Museum's former Hillcrest No. 9 (Climax 1359), as the only surviving intact Climax in Canada, should receive particular care and attention. The other machine of unusual interest is "Old Curly," both because of its early history and since it represents a small, turn-of-the-century, logging locomotive. Fortunately, several of the other significant machines – a Pacific Coast Shay and three Class B Shays – are in good repair. Only three or four of the rod locomotives are in good condition and of these only one has been under cover since being withdrawn from service. This machine, Baldwin 60942, provides the best remaining opportunity for simple conservation of an engine in operational condition. All other locomotives would require extensive repairs and restoration to bring them to a reasonable state of preservation or maintenance.

Overall, the record is laudable and many machines were saved. In fact nearly all steam logging locomotives surviving after the early 1960s were preserved. Preservation efforts were often unco-ordinated, however, and some important machines were missed. Certainly there was no systematic effort to select and preserve machines other than the private efforts of Gerald Wellburn, founder of the British Columbia Forest Museum, whose work is evident in the collections now on display at Duncan. Corporate interest by both the Hillcrest Lumber Company and Comox Logging and Railway Company was also important. Interest by government bodies did not occur until the late 1960s or early 1970s when the surviving MacMillan Bloedel engines were acquired by the province.

As other forms of industrial technology become obsolete, responsible historical institutions will be faced with hard choices about which, if any, artifacts are to be preserved. These choices should be based on well-reasoned criteria applicable to each industry and which define such considerations as representativeness, the history of the artifacts, technological features, important technological changes and innovations, and the significance of the artifact to the overall history of the industry, or at least a component of the industry. However, once technology is obsolete it may already be too late to define these criteria adequately so that the answers may in fact lie in a careful mon-

itoring of industrial change as much as in historical analysis. Had the basis been laid in the early 1950s for a programme of logging locomotive preservation based on a study of the types used in the province, perhaps a more representative, historically more interesting collection of logging locomotives would have been preserved in British Columbia. Retrospectively, such an analysis has provided an indication of significance for restoration, conservation, and interpretation of the surviving artifacts. Additionally, such information is applicable to museum exhibits on the industry by suggesting which types of equipment should be represented in illustrations, models, and graphics, and as background for exhibit interpretative information.

APPENDIX

Logging Railroad Rolling Stock

Because the logging railroads were built to carry a single commodity, logs, the types of rolling stock were limited. There were also three basic types of log cars as well as a very limited amount of special equipment such as snow plows and speeders (crew cars).

The first and most primitive type of log car was the disconnect truck. These were operated in pairs and were basically freight car trucks with a bolster across them to support the logs. They could be coupled together when empty but when loaded were moved apart a sufficient distance to support the ends of the logs being carried. Their main drawback was that they could not be readily fitted with air brakes. These were seldom used after the 1920s in British Columbia and as far as can be determined none has been preserved in the province.

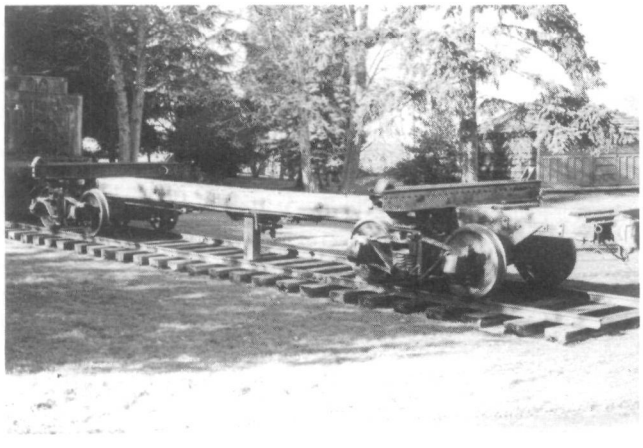

Fig. 6. A skeleton-type log car displayed by Crown Zellerbach Canada at Ladysmith, B.C. The vertical timber under the centre of the car is to support the wooden centre sill of the car and the attached air brake equipment. (Photo: BCPM, uncatalogued.)

The second and apparently most common log car was the so-called skeleton car. It had a basic frame built between two freight car trucks, an arrangement which permitted air brakes to be applied while maintaining its light weight and easy maintenance (see fig. 6). The third type was the more-or-less standard railroad flatcar equipped with log bunks. Drawbacks of these cars were their greater weights, higher cost, and the tendency of the cars to accumulate bark and other debris on the deck, adding nonproductive weight.

There was also specialty equipment used for moving heavy machinery, for trade maintenance, firefighting, and for carrying the loggers themselves. These were basically standard railroad equipment modified to suit the needs of individual companies. The general references noted in the paper all include summary descriptions and illustrations of the more common types of logging railroad equipment.

NOTES

1. While statistical evidence is lacking on volumes of logs hauled, annual surveys of the logging industry for this period indicate clearly the dependence of the major producers on logging railroads, e.g., *The Timberman: Directory of the Lumber Industry, 1906, 1924,* and *1935* (Portland, Oreg.) and Province of British Columbia, Department of Railways, *Annual Report 1954* (Victoria, B.C.). The dominance of logging railroads in log transport was also evident throughout the western United States, e.g., William H. Gibbons, *Logging in the Douglas Fir Region,* United States Department of Agriculture Bulletin 711, November 1918 (Washington, D.C.) and Nelson G. Brown, *Logging, the Principles and Methods of Harvesting Timber in the United States and Canada* (New York: John Wiley & Sons, 1949).
2. Brown, *Logging* and Robert D. Turner, *Vancouver Island Railroads* (San Marino, Calif.: Golden West Books, 1973), ch. 5.
3. No complete rosters of railway equipment on all logging railroads have been published, but no steam locomotives which existed, intact, in British Columbia after 1962 have been scrapped.
4. General references include Gibbons, *Logging in the Douglas Fir Region;* Brown, *Logging;* John T. Labbe and Vernon Goe, *Railroads in the Woods* (Berkley, Calif.: Howell-North, 1961); Kramer Adams, *Logging Railroads of the West* (Seattle, Wash.: Superior, 1959); Michael Koch, *Steam and Thunder in the Timber: The Saga of the Forest Railroads* (Denver, Colo.: World Press, 1980).
5. Brown, *Logging,* pp.331-2.
6. Gibbons, *Logging in the Douglas Fir Region,* p.179.
7. Ibid., pp.179-200 provides a detailed discussion of locational considerations in logging railroad construction.
8. Gibbons, *Logging in the Douglas Fir Region,* pp.179-200 and Brown, *Logging,* pp.331-2.
9. The patterns are clearly evident in the 1950 series of 1:50,000 topographic sheets, B.C., Department of Lands and Forests, (Victoria, B.C., 1950). See also Turner, *Vancouver Island Railroads.*
10. Brown, *Logging,* pp.213, 216, 220, 222.
11. See B.C., Department of Lands and Forests, Surveys and

Mapping Branch, Oyster River Map Sheet 92F/14, 1957 Series (Victoria, B.C., 1957).

12. Brown, *Logging,* ch. 17.
13. B.C., Department of Railways, *Annual Reports* and interview with Gerald E. Wellburn, founder of the British Columbia Forest Museum, in Victoria, B.C., 1981.
14. Based on surveys of archival photos and all other available evidence.
15. These exceptions were the Shawnigan Lake Lumber Company for a period of about two years ca. 1902 (see Robert Griffin, "The Shawnigan Lake Lumber Company, 1889-1944" M.A. Thesis, University of Victoria, 1979) and an unidentified operation near Cranbrook.
16. Frank Beban operated this line near Haslam Creek on Vancouver Island. (Interview with Wellburn, 1981.)
17. Brown, *Logging,* ch. 17 and Gibbons, *Logging in the Douglas Fir Region,* pp.175-216.
18. Interview with Tom Coates, Victoria, B.C., 1980. Mr. Coates noted that the Merrill, Ring and Wilson logging company at Rock Bay on Vancouver Island operated with a steep adverse grade during the 1930s. Reconstruction was desirable to avoid this grade but could not be justified.
19. Gibbons, *Logging in the Douglas Fir Region,* p.181.
20. Robert D. Turner, *Railroaders: Recollections From the Steam Era in British Columbia,* Provincial Archives of British Columbia, Sound Heritage Series no. 31 (Victoria, B.C., 1981), pp.68-79.
21. See B.C., Department of Railways, *Annual Reports, 1945* and *1964* and *The Timberman: Directory of the Lumber Industry, 1906* and *1924* (Portland, Oreg.).
22. Robert D. Turner, "Logging in the Queen Charlottes," *Pacific News* 13, no. 1 (January 1973): 3-7.
23. Turner, *Vancouver Island Railroads,* ch. 5 and B.C., Department of Railways, *Annual Report, 1955.*
24. *The Timberman: Directory of the Lumber Industry, 1906* and B.C., Department of Railways, *Annual Report, 1919.*
25. Statistics compiled from *The Timberman: Directory of the Lumber Industry, 1924* and B.C., Department of Railways, *Annual Report, 1924.*
26. Brown, *Logging,* ch. 16.
27. Michael Koch, *The Shay Locomotive, Titan of the Timber* (Denver, Colo.: World Press, 1971), ch. 10.
28. Koch, *The Shay Locomotive,* pp.460-65.
29. B.C., Department of Railways, *Annual Report, 1956.*
30. B.C., Department of Commercial Transport, *Annual Report, 1960* and Turner, *Vancouver Island Railroads,* ch. 5. The companies were Canadian Forest Products, Crown Zellerbach Canada, and MacMillan Bloedel.
31. Brown, *Logging,* p.345, also pp.307-16.
32. B.C., Department of Railways, *Annual Report, 1956,* pp. HH 16; B.C., Department of Commercial Transport, *Annual Report, 1970;* Turner, *Vancouver Island Railroads,* pp.157, 165-67.
33. Gibbons, *Logging in the Douglas Fir Region,* pp.204-8. Labbe and Goe, *Railroads in the Woods,* pp.83-114, 215-38.
34. Labbe and Goe, *Railroads in the Woods,* pp.215-38.
35. No complete roster is available; based on the sources noted in table 2.
36. See Robert A. LeMasenna, *Articulated Locomotives of North America* (Silverton, Colo.: Sundance Publications, 1979) and Labbe and Goe, *Railroads in the Woods,* pp.215-38.
37. The general references noted in note 4 provide summaries of locomotive types as does Koch, *The Shay Locomotive,* ch. 12, which details the technology of logging locomotives. Koch elaborates on this discussion in *Steam and Thunder in the Timber,* pp.33-62.
38. The best references are Koch, *The Shay Locomotive;* Dan Ranger, Jr., *Pacific Coast Shay* (San Marino, Calif.: Golden West Books, 1964); and Thomas T. Taber and Walter Casler, *Climax: An Unusual Locomotive* (Morristown, N.J.: Railroadians of America, 1960).
39. Koch, *The Shay Locomotive,* ch. 5-11; Lima Locomotive Works, *Lima Geared Locomotives Catalogue No. S-4* (Lima, Ohio, 1925) and Lima Locomotive Works, *Lima Locomotive Works Catalogue No. 16* (Lima, Ohio, 1911).
40. Taber and Casler, *Climax: An Unusual Locomotive;* Climax Manufacturing Company, *The Climax Patent Geared Locomotive* (Erie, Pa., [1910]) and Climax Manufacturing Company, *The Climax Patent Geared Locomotives* (Erie, Pa., 1924).
41. Taber and Casler, *Climax: An Unusual Locomotive;* Heisler Locomotive Works, *Heisler Geared Locomotives: Description of the Patented Construction* (Erie, Pa., [1924]) and Heisler Locomotive Works, *Why You Can Haul at Least 35% More Per Ton of Locomotive With the Modern Heisler* (Erie, Pa., [1928]).
42. Lima Locomotive and Machine Company, *Instructions for the Care of Shay Geared Locomotives* (Lima, Ohio, [1910]). See also the general references cited in note 4.
43. Ranger, *Pacific Coast Shay,* pp.50, 106-7 and Steve Hauff and Jim Gertz, *The Willamette Locomotive* (Portland, Oreg.: Binford & Mort, 1977), pp.55-62.
44. See Koch, *The Shay Locomotive* and Koch, *Steam and Thunder in the Timber,* pp.45, 50, 55.
45. Identified from photos held in various collections in British Columbia.
46. Hauff and Gertz, *The Willamette Locomotive,* pp.55-64. This study also notes a comparison between a Shay and a comparable Willamette.
47. Turner, *Railroaders,* pp.68-80.
48. See the general references cited in note 4. These observations are also evident from the equipment listings in the B.C. Department of Railways *Annual Reports,* e.g., 1924.
49. Canadian Forest Products and Crown Zellerbach, both on Vancouver Island. See Turner, *Vancouver Island Railroads,* pp.157, 165 and "Canadian Forest Products," British Columbia Railway Historical Association Bulletin no. 2, mimeographed (Victoria, B.C., 1960).
50. British Columbia Forest Products and MacMillan Bloedel are examples.
51. *The Timberman: Directory of the Lumber Industry, 1928.*
52. Koch, *The Shay Locomotive,* ch. 9-11.
53. See Raymond F. Corley, *Preserved Canadian Railway Equipment* (Montreal: Railfare Books, 1971), pp.24-35.
54. Interview with Gerald E. Wellburn, Victoria, B.C., 1980.
55. The Shays were limited because of their slow speed; hence their turn-around time was much longer than the faster rod locomotives.
56. Compared, for example, to machines of the late 1920s, such as Baldwin 60942, which were larger, superheated, and equipped with piston valves.
57. Stored by MacMillan Bloedel at Chemainus, B.C., for the British Columbia government.
58. All have been seen by the author in the last few years.