

A Historical Context for the Eugene Millrace and Intake Structures

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Eugene Millrace

The Eugene Millrace, constructed by Hilyard Shaw in 1851, played a major role in the economic development of Eugene. Over time, the millrace provided the motive power for almost a dozen industrial plants. Shaw, an early Donation Land Claim settler along the banks of the Willamette River on the southern edge of the village of Eugene, saw the possibilities of connecting the two sloughs on his property to create a millrace, which could produce water power to run a sawmill he planned to start up. One slough began at Judkin's Point at a bend in the Willamette River as it flowed north. The other slough, a short distance farther west, emptied back into the Willamette at a point farther downstream. Using hand shovels and a team of oxen pulling a scraper, Shaw and his helpers, dug a ditch about five blocks long to connect the sloughs. Before Shaw linked the two draws, the western slough was probably dry, except when high water from the Willamette backed up into it.¹

With a steady flow of water in the millrace, Shaw constructed his sawmill along the lower portion of the millrace. In 1855, another entrepreneur built a flour mill adjacent to Shaw's sawmill. Soon, various other mills and factories developed on a 23-acre tract through which the lower millrace flowed. Over the next forty years, the millrace and the 23-acre tract went through several changes of ownership. At times, the ownership of the millrace and its power easement became separated from the mill property. In 1877, a group of investors and mill owners lead by William Edris and A. S. Patterson bought the waterway and water power right, again linking the millrace with the 23-acre mill property until 1886, when some parcels were sold off to various industries located on the mill property. By 1891, Edris had become the sole owner of the

millrace and remaining mill property (see app., fig. 2). Through all of the changes in ownership, the deeds' grant of the easement for power generation generally read as follows:

. . . together with all the water power upon said premises also the right to dig the present raceway as deep and wide as may be required to run the mills thereon, and all other mills or machinery that may at any time or times be placed on said premises, also the right to dig the present raceway as deep and wide as may be necessary and bank the dirt and stone on either side, also to include sufficient dirt and stone lying adjacent to the dams for the purpose of keeping them in repair , also the right to take water out of the dam for other mill purposes by increasing the flow to the extent of the water so taken out.

Between 1877 and 1898, the various millrace proprietors made significant improvements to the waterway, widening and deepening the channel, and expanding a timber crib dam at the intake point on the Willamette River.²

The millrace owners undertook improvements over time to accommodate the growing number of industries drawing on the available water power supplied by the millrace. The industrial concerns, located on the 23-acre tract, expanded to include a lumber mill, produce cannery, sash and door factory, cider and vinegar plant, furniture factory, excelsior plant, ice plant, woolen mill, tannery, and flour mill. As each factory started up, it had its own race from the mill pond fed by the millrace (see app., fig. 3). In his 1884 history of Lane County, A. G. Walling noted, for instance, that the Eugene City Flour Mill's "waterpower is supplied by a natural race which flows from the Willamette River about two miles above the mill buildings, which puts the Leffell Turbine wheel in motion, and besides furnishes the motor for other manufacturing establishments. This water is owned by the mill company."³

During the nineteenth century, water power played a key role in the industrialization of the United States. Where a sufficient volume and force of water existed to drive a wheel or

turbine, water power could be harnessed to drive the machinery of a factory. The volume of water was measured in cubic feet per second (cfs), and the force (the distance between intake and mouth of a channel) was measured in feet of head. Engineers developed several types of wheels to accommodate varying conditions of volume and force for the machinery that needed to be driven. Power was transferred from the turbine to individual machines by various shafts, gears, and belts. By the 1860s, horizontally mounted turbines became the most common design, and of these the most popular was the Leffel wheel, made of iron or brass (see app., fig. 1). It used every inch of head and fall, having an efficiency of 92 to 95 percent and could operate in streams with a low head. In addition, the Leffel Turbine was relatively inexpensive to build and maintain. These factors were a great advantage over the wooden overshot wheel, which had proved to be unwieldy, inefficient, and expensive to repair.⁴

The Hudson's Bay Company made the first use of water power in the Oregon Country in 1828, to run a saw mill. Other early uses of water power occurred in the Willamette Valley at Oregon City in 1832 and Champoeg in 1836. By the time Shaw operated his saw mill with water power at Eugene, a number of other water powered mills had started up in such Willamette Valley settlements as Lebanon and Brownsville, Oregon. Within the United States during the nineteenth century, most of the large-scale, direct drive water power developments occurred in New England.⁵

Over time, steam power displaced water power as a driver of industrial development in the United States. Steam had many advantages over water power. It was especially attractive for processes that produced heat or produced scrap wood that could be burned to fire boilers. Steam power also increased the options for locating factories, since it was not tied to a specific

waterway or affected by droughts or floods. Improvements, moreover, in the efficiency of boilers and engines reduced the cost of steam powered manufacturing, furthering steam power's advantage over water power. By 1870, water power had reached its peak as a source for industrial power in both the nation and Oregon. At that time, water power accounted for 48 percent and 71 percent, respectively, of the total power for the United States and Oregon. In 1880, water power's percentage of total power had dropped nationally to 36 percent and 68 percent in Oregon. By 1910, Oregon's water power produced only 27 percent of the state's primary power. During the early twentieth century the development of cheap hydroelectric power that could be transmitted over long distances also became a factor in the replacement of direct-drive water power. Finally, in 1930, water power accounted for only 11 percent of Oregon's aggregate primary power.⁶

The water power from the Eugene Millrace enabled the rise of industry, which in turn, helped propel the growth of Eugene. A writer in the *Eugene City Guard*, in 1890 noted that Eugene had a great economic advantage over rivals, for "with her magnificent water power she can produce as cheaply as required anywhere." From a population of 861 recorded in 1870, the town reached 3,236 in 1900. By 1910, Eugene had 9,009 inhabitants, an increase of 178 percent over the preceding census. To some degree, Eugene's growth in the first decade of the twentieth century reflected larger economic and social trends at work in Oregon and especially the Willamette Valley. During that ten-year period, the state's population increased 62.7 percent, with some cities showing especially robust growth. Portland, for example, grew from 90,426 to 207,214—a 129 percent increase. In a like manner, Salem experienced a population increase of 231 percent, while Medford grew 393.6 percent during that time period. In general, Oregon's growth reflected rapid agricultural development and increased exploitation of its natural

resources such as timber and precious minerals. In addition, the Lewis and Clark Exposition had a marked effect on Portland's growth after 1905. In the case of Eugene, however, the millrace helped spark the city's growth because it could supply cheap power for the development of factories that processed the bountiful agricultural and timber resources from Eugene's hinterland.⁷

Until the railroad arrived in 1870, Eugene depended on shallow-draft steamboats operating on the Willamette River to reach markets outside of the Willamette Valley. The upper Willamette river channel, however, was unstable; and steamboats could operate safely only during high water periods. From 1871 to 1904, the U. S. Army Corps of Engineers sought to maintain a navigation channel 2.5 to 3.5 feet deep between Oregon City and Eugene by removing snags; building wing dams, pile dikes, and bank revetments; and scrapping or dredging bars in the river. The last attempt to operate a regular steamboat schedule between Portland and Eugene occurred in 1899, but it was unsuccessful. Since steamboat companies made only sporadic attempts to provide river transport, the railroad supplied the only reliable means of transporting bulk agricultural products from the upper Willamette Valley and bringing in finished goods. Beyond the growth of agriculture and industry, Eugene also got an economic boost when the state chose the city as the location for the state university in 1876.⁸

As the addition of new industries increased the demands on the millrace, floods on the Willamette River in the early 1890s threatened its operation. After a serious flood in the spring of 1890, both Eugene newspapers, the *Guard* and the *Morning Register*, reported major repairs to the millrace. According to the *Guard*,

the Eugene Mill Company are at work making improvements on the mill race where it leaves the river, that will greatly increase the efficiency of the water power and render it less liable to damage from high water. A crib will be built from the end of the dam that parallels the bank at a point where the bottom commences at Judkin's point. A race will then be dug following the county road to the river, a few hundred yards above where a mouth can be secured that is not liable to be damaged by freshets. A gain of about three feet in fall will also be secured in that short distance that will be a decided advantage.

The *Morning Register* noted in its report that as the new channel "comes out at the bend in the river a strong current will be thrown into the head of the race, giving a largely increased flow of water. . . . The race has not carried as much water heretofore as has been desired but with the improvements now being made there will probably be all that can be used." After another high water event in December 1891, the *Guard* reported that "about forty feet of the mill dam near the University on the east side washed partly away, entailing some damages on the Mill Company," and that "men are busy at work repairing the break." This flood caused the main channel of the Willamette River to shift south, bypassing the existing northern bed and creating a fresh meander scar to the north of the Day Island area. Further floods damaged the millrace headworks in 1902 and 1904. For instance, in October 27, 1902, the *Daily Guard* reported that "a visit to the manufacturing portion of the city this morning found a stillness like hard times about the factories. Not a wheel was turning. . . . The mill race near Judkins' Point was being repaired and there was no water for power."⁹

In 1898, the remaining mill property and millrace once again changed hands when William Edris sold the properties to George Midgley and Frank Chambers. By this time, Edris had sold parcels of the original 23-acre mill property to other interests, such as the Upper Willamette Lumber Company, Eugene Canning and Packing, and the Eugene Mill and Elevator Company. With the gradual separation of the mill properties and millrace, Midgley and

Chambers decided to concentrate on improving the millrace and power supply, independent of the remaining mill property. They were determined to use the water power provided by the millrace to further the industrial growth of Eugene. As the *Morning Register* noted at the time of the mill property transfer, "this is a valuable piece of property, as it is one of the best water powers in the upper Willamette valley. The purchases are young, energetic wide-awake business men, who will improve the property as occasion demands."¹⁰

Although difficult to document precisely, Chambers and Midgley carried out a number of improvements to the millrace and its headworks over time (see app., photos, 1, 3-4). Their predecessors had built a wing dam into the Willamette River at the head of the race to divert water from the river. In late 1901, Midgley and Chambers apparently began extensive improvements on the dam in the Willamette, ultimately costing about \$6,000. Midgley and Chambers had constructed the diversion dam of brush and rip rap, and each year freshets partially washed the structure away, necessitating annual reconstruction. As previously noted, the Corps of Engineers had responsibility for this section of the Willamette River, since they maintained a shallow-draft navigation channel to Eugene until 1904. After receiving a complaint about the dam, the engineer officer in charge of the Portland District of the U. S. Army Corps of Engineers, informed Chambers that under the terms of Section 10 of the Rivers and Harbors Act of 1899, he needed a permit for any construction in a navigable river. The law charged the Corps of Engineers with preventing obstructions to navigation; and the operation of the dam caused scouring on the left river bank, which had the potential to affect navigation downstream. After making proper application, Midgley and Chambers received permission from the Corps of Engineers to erect and maintain a dam in the Willamette River, provided they made provision for running logs over the dam and protecting the south bank of the river opposite the dam from

scour. As noted above, further repairs to the millrace intake were necessary in October 1902. According to Robert Tweedell, writing about the millrace in 1949, the dam improvements had been necessary to overcome the lowering of the river bed by over five feet as a result of previous Willamette River floods.¹¹

In 1906, Chambers and Midgley incorporated the millrace and related property as the Chambers Power Company to better carry out their improvement plans. By 1910, the Chambers Power Company faced increased pressure to make major changes to the millrace by widening and deepening it. Even though the company had constructed a rock retaining wall a half-mile above the head of the of the race to keep the Willamette in its channel, the shifting river threatened to leave the millrace dry. According to a report in *The Eugene Daily Guard*, in February 9, 1910,

The river is changing its course around the 'Dolly Varden' rapids at Judkins point so that someday the mill race may be cut off from its supply of water. A channel has already been cut on the north side of the river and a portion of the river is now flowing through it. The river has until now flowed over the rock jump-off, as it were near the 'island,' and readily flowed into the mill race except in summer when a dam has to be built to divert the water. The new channel is cutting through the gravel and starts a hundred yards or so above the rapids and has a straight shoot with a gradual fall. The new course will be a natural channel, for the old one makes a sharp curve at this point and a diagonal gravel bar tends to send the water in this direction. If the river changes this way it will be a matter of much expense to get any water into the mill race, for a permanent dam will have to be built.

In October 1910, Frank Chambers, now the driving force of the Chambers Power Company, announced major improvements to the intake of the millrace and widening and deepening of the race itself. He promised none of the work would harm property owners along the banks of the millrace. The property owners, however, feared for the worse. Over time, they had developed

beautiful lawns and gardens and opposed any work on the millrace that might affect their property and potentially reduce its value.¹²

Chamber's work on the dam and millrace apparently involved raising the height of the dam to increase the amount of water diverted. This action, coupled with his enlargement of the millrace itself caused the property owners along the banks of the race to complain to the Corps of Engineers in Portland. They alleged that Chambers was violating the terms of his permit to build and maintain the dam and that the operations of the millrace damaged their property. Specifically, they claimed that the increased flow in the millrace raised the water table and flooded their basements. The Army Corps of Engineers' Portland District Engineer travelled to Eugene to personally inspect the dam, and asked Chambers to justify his operations of the structure. After his examination, the District Engineer reported to the Army Corps of Engineers' Chief of Engineers in Washington, D. C. that "as far as the interests of navigation are concerned, there is no damage either existing or complained of. . . . The dam is located about 22 miles above the point now considered as the head of navigation [Harrisburg, Oregon] on the Willamette River."¹³

Chambers denied that he had increased the height of the dam or the flow into the millrace and asserted that any increased flow in the millrace resulted from freshets in the river. He did admit, however, in a letter to the *Eugene Daily Guard*, "the raceway has been widened and deepened, and the adjoining banks built up," adding "we hope to do more in the future." The Army Corps of Engineers' Portland District Engineer admitted that it was difficult to determine the exact height of the dam and concluded that "the damage resulting from flooding the property of the various citizens may be due to the construction and maintenance of the millrace . . . but it

does not appear to be caused by the dam and the effect of the dam is the only feature . . . within the jurisdiction of the War Department.” The Portland District Engineer went on to observe that “this mill race and the dam in the river have been maintained for nearly 60 years and the owners claim that their deeds give them the right to dig the mill race as deep and as wide as may be necessary. For damage caused by flooding from the mill race, the petitioners have recourse in the State Courts.” The Secretary of War, through the Chief of Engineers, concurred with the opinion of the Portland District Engineer.¹⁴

The quarrel between the Chambers Power Company and the homeowners along the millrace created quite a public controversy in Eugene. The two daily newspapers gave it considerable coverage but ultimately expressed exasperation that the parties could not resolve their differences. The *Morning Register* editorialized that “there ought to be some way of adjusting these matters for the good of all concerned. We need the millrace as a beauty spot and more especially for power purposes. The business interests, Mr. Chambers and the residents along the race ought to be able to get together in some way on an adjustment of matters that will result in the good of all. We feel that to cut out this water power would be a bad thing for the city.” For its part, the *Eugene Daily Guard*, wanted “to prevent useless recriminations and personalities, and at the same time treat all concerned with equal fairness” in reporting on the controversy. To that end, the editor observed, “We think this controversy has really gone too far now. All the interest The Guard, or any citizen outside of those directly concerned, has in the matter is the hope that a course may be agreed upon which will conserve the best interests of the city.”¹⁵

Failing in their efforts to get the Corps to revoke Chamber's permit to build and operate a dam in the Willamette River, the aggrieved homeowners next turned to the state courts for redress of their alleged damages that stemmed from the increased flow in the millrace. Tensions between the homeowners and Chambers had been high during the summer of 1910. When employees of the Chambers Power Company attempted to cut brush along the millrace, an enraged woman ordered them away at the point of a shotgun. The competing claims of the Chambers Power Company's flowage easement and homeowners' property rights slowly made their way through the state courts. Finally, after three years of litigation, the Oregon Supreme Court resolved the case in 1916. The Supreme Court found in favor of the Chambers Power Company but set limits to their easement:

The defendants [Chambers Power Company] will be permitted to widen their ditch so as to bring it up to 50 feet in width, and will be enjoined from further widening it, and from throwing mud and silt from the bottom upon adjacent property.

The Court made its decision based on the clear language of Shaw's deed, which left "no room for speculation":

The grant made by Shaw created an encumbrance, and parties [homeowners] making improvements along the route of the ditch and near enough to be affected by any probable widening of it that the grantees might make, made them at their peril. There is no evidence of acquiescence in the improvements by defendants further than that they did not actually object to them. . . . Defendants' relation to the water right and way in question is fixed by the deed, which, in effect, grants to them all power then produced through the agency of the ditch, and as much more in the future as can be used in factories erected on the 23 acre tract.¹⁶

During the years of litigation, Chambers continued to supply waterpower to five industries dependent on this source of power; but no new factories located on the millrace property. The remaining businesses included the Eugene Woolen Mills, the Eugene Excelsior

factory, the Midgley Planning Mill, the Eugene Flouring Mill, and Eugene Ice and Storage Company. By this time, the original tract owned by the Chambers Power Company had been reduced to 10 acres from the original 23 acres; and the company had been stymied in its intent to expand the power supply provided by the millrace. Just prior to the state courts settling the litigation, the Chambers Power Company sold the millrace and waterpower easement in June 1915 to the Eugene Woolen Mills and the Eugene Excelsior Company for \$10,000. The deed conveying ownership of the millrace was not filed until March 1917. The two companies made separate purchase of their factory property and continued to use the waterpower supplied by the millrace until 1928. At that time, a flood damaged the headworks, and cheaper power from hydroelectric sources made repairs uneconomical. The factory water wheels permanently ceased operations.¹⁷

Even during the heyday of waterpower, the millrace had developed importance as a recreational amenity (see app., photo 2). As early as 1884, townspeople and university students took up ice skating on the millrace when it froze over. During the 1890s, recreation use extended to boating on the millrace. Boating became so popular that Chambers opened a boathouse on the millrace in 1906, and another businessman established a second boathouse in 1911. Over much of the twentieth century, the millrace continued to experience heavy recreation use, especially by university students. In October 6, 1910, the *Eugene Daily Guard* observed that the millrace was “used by hundreds of canoe and boat owners for pleasure boating.” During the 1940s and 1950s, the university students helped spearhead the efforts to save the millrace.¹⁸

In the early 1940s, a series of floods destroyed the intake channel and the diversion dam and left the millrace dry. In the late 1940s, highway planners sought to encroach on the millrace

by incorporating it into plans for relocating an adjacent highway and railroad tracks. In 1947, the City of Eugene bought the millrace to provide a base for the Ferry Street Bridge and to allow the remainder of the old millrace to once again be used for recreational boating. Although the city repaired the intake channel in 1949 and refilled the millrace, the new pipe used to reconnect the intake channel and the pipe under the highway were not large enough to provide an adequate flow. Finally, in about 1958, after public pressure, the city and the University of Oregon installed pumps to increase the millrace flow. This action followed an agreement between the City of Eugene and the University of Oregon in 1947 to restore the recreational use of the millrace, maintain the functional use of the millrace as a part of the city's storm sewer system, and to provide cooling water for the University's heating and power plant.¹⁹

Until recently, the University of Oregon maintained the pumps to insure that it could use water from the millrace for cooling its facilities heating plant. In November 2009, however, the University ceased using millrace water for its heat exchange system when it switched to a new chilled water plant. While the University plans to continue maintaining the millrace as it has since the 1950s under a joint agreement with the city, the future of the millrace remains unclear. The University draws on the millrace water rights, including 13.2 cfs for cooling purposes and another 31.6 cfs for recreation. The City of Eugene has yet to decide its future interest in the millrace.²⁰

Given the current state of the documentary evidence, it is impossible to determine exactly when the concrete diversion dam and headworks of the Eugene Millrace were constructed. The existing physical remnants of the works, moreover, are highly disturbed from repeated floods

and highway and bridge construction; the remnants provide no readily identifiable markings or engineering elements that would help in dating their original date of construction.

Between 1851 and 1890, the Willamette River channel apparently provided an easy gradient into the opening of the millrace, and the operators of the power right needed minimal engineering works to receive and deliver a sufficient flow to drive the Leffel Turbine water wheels running the factories on the millrace. Between 1890 and 1902, a series of floods began to change the river's channel to the extent that the millrace and water right owners found it necessary to construct a more substantial diversion dam and headworks to secure the necessary flow in the millrace. In 1902, Frank Chambers, the principal owner of the millrace, applied for a permit from the Army Corps of Engineers to build a diversion dam in the Willamette River, a navigable body of water, to better supply the millrace with water. Unfortunately, the permit no longer exists in the Portland District of the Army Corps of Engineers' records held at the National Archives branch in Seattle; but according to the surviving correspondence from 1910-1911 for the Corps' Portland District office, the 1902, low diversion dam was built of rocks and brush. No mention was made of the intake structure construction process in either newspaper accounts or the Corps' records of the period between 1902 and 1910.

In the fall of 1910, homeowners along the banks of the millrace complained that Chambers had increased the height of the dam and thereby the flow in the millrace to the detriment of the property owners. Chambers denied this and the Corps of Engineers could not confirm that he had raised the dam's height. In their complaint about millrace operations, the homeowners stated that the millrace lacked head gates near the intake of the race (see *Eugene Daily Guard*, Jan. 17, 1911) necessary to regulate the flow of water. Since the homeowners sued

Chambers in 1913 for property damages and the suit took three years to resolve, it is highly unlikely that Chambers would have made any costly changes to the dam and headworks after 1913. In fact, Chambers subsequently sold his mill property and power right in 1915 to the Eugene Woolen Mills and the Eugene Excelsior Company. Since these two businesses continued to operate the millrace for power purposes until 1928, it is possible they installed the concrete elements at the diversion dam and headworks sometime during their ownership (see app., figs., 4-5). It seems unlikely that any significant work would have occurred after 1928, especially during the Depression of the 1930s and the national emergency of World War II. Floods in the early 1940s once again severely damaged the millrace intake area and the intake was moved downstream in the 1950s. To date, no records have been found to clarify the time of concrete construction at the headworks of the Eugene Millrace, but the most likely times would have been between 1910 and 1913 and/or possibly 1917 and 1928.

A major purpose of the foregoing history of the millrace and headworks was to gain a better understanding of their construction and operation so as to interpret the extant concrete remains of these features at the historic millrace intake. The information could be used to provide appropriate onsite, public interpretation of the headworks remnants. The existing millrace intake elements include the following²¹:

- (1) Mid-channel concrete buttress elements of the diversion dam formerly associated with timber cribs holding rocks and brush.
- (2) Weir/intake bay extending slightly upriver from the diversion dam that directed water into the millrace channel.

- (3) Remnants of the concrete walls that served as the head of the millrace and that created a fairly uniform 100-foot-wide channel that extended from the weir to the log crib. This section likely underwent regular repairs and modifications through 1942 in response to numerous floods.
- (4) Log crib which probably functioned as a removal gate for log rafts. The Corps of Engineers required this element in 1902 when it granted a permit for the in-water portions of the headworks.
- (5) Intake gate which funneled water into the millrace channel just downstream from the log crib. The existing buttress wall visible from the bike path may be a support for the angled intake wall. The angled concrete wall apparently constricted the flow of water entering the millrace as it extended downstream. Probably built after 1910.
- (6) Concrete channel walls existing as discontinuous remnants downstream. Apparently, underwent repairs in response to numerous floods prior to 1942.

Based on existing documentary evidence, it is not possible to establish definitive dates for when the extant concrete elements were constructed. It can be stated that when the Corps of Engineers issued the permit for the diversion dam in the Willamette River, the structure was described as being made of brush, rock and timber, with no mention of concrete. When the Corps of Engineers reexamined the diversion dam in 1910, they did not indicate any changes in its materials. The best available evidence would seem to indicate that the extant concrete elements were put in place and maintained by the Chambers Power Company and its successors between 1910 and 1928.

¹ Bob Tweedell, *Millrace History* (Eugene, OR: *Eugene Register-Guard*, 1949), 1-3.

² *Ibid.*, 6-8; Judith Rees, "The Millrace" (master's thesis, University of Oregon, 1975), 21-28, 71-73, appendix A; *Eugene Daily Guard*, Oct. 12, 1910.

³ A. G. Walling, *Illustrated History of Lane County, Oregon* (Portland, OR: A. G. Walling, 1884), 393, 403, quote in 439; Eric Jones, "Industrial Uses of the Millrace and Its Area: 1851-1928 (unpublished paper, on file, Lane County historical Museum, Eugene, OR., 1981), 7-9; Alfred Lomax, *Later Woolen Mills in Oregon* (Portland, OR: Binfords and Mort, 1974), 126.

⁴ Jones, "Industrial Uses of the Millrace," 3-4; Robert B. Gordon and Patrick M. Malone, *The Texture of Industry: An Archaeological View of the Industrialization of North America* (New York: Oxford University Press, 1994), 60-63, 89-94; *Illustrated Catalogue, Jas. Leffel's American Double Turbine Water Wheel* (Portland, OR: Oregon Iron Works, 1866), <http://www.archive.org/details/illustratedcata100jamerich> (accessed Dec. 18, 2009). The Eugene Millrace had a fall between 16 and 20 feet; *Souvenir, National Editors Association, 1899* (Eugene, 1899), 11.

⁵ Jones, "Industrial Uses of the Millrace," 5; Gordon and Malone, *The Texture of Industry*, 89-94; William H. Pierson, Jr. *Technology and Picturesque, the Corporate and Early Gothic Styles* (New York: Oxford University Press, 1978), 22-32, 37-42.

⁶ Jones, "Industrial Uses of the Millrace," 24-26; Gordon and Malone, *The Texture of Industry*, 99-108.

⁷ *Eugene City Guard*, June 7, 1890; Bureau of the Census, *Thirteenth Census of the United States, 1910* (Washington, DC: Government Printing Office, 1913), 569; for Oregon growth, see William G. Robbins, *Landscapes of Promise: The Oregon Story, 1800-1940* (Seattle, WA: University Washington Press, 1997), 179-237; on the effects of the Lewis and Clark Exposition, see Carl Abbott, *The Great Extravaganza: Portland the Lewis and Clark Exposition*, 3rd. ed. (Portland, OR: Oregon Historical Society Press, 2004).

⁸ William F. Willingham, *Army Engineers and the Development of Oregon: A History of the Portland District U. S. Army Corps of Engineers* (Washington, DC: Government Printing Office, 1980), 19, 25, 37, 55-58; Maj. James MacIndoe to Chief of Engineers, Dec. 8, 1910, RG 77, National Archives, Seattle (hereafter, NAS), Portland District (hereafter, PD), Entry 37, Box 3.

⁹ *Eugene City Guard*, July 12, 1890; *The Eugene Register*, July 16, 1890; *Eugene City Guard*, January 2, 1894; Jones, "Industrial Uses of the Millrace," 9; Lomax, *Later Woolen Mills in Oregon*, 127-28; *Eugene Daily Guard*, Oct. 27, 1902.

¹⁰ *Eugene Morning Register*, July 30, 1898; Rees, "The Millrace," 27-28.

¹¹ Capt. William Langfitt to I. L. Campbell, Dec. 18, 1901, RG 77, NAS, PD, Entry 3, 52; Capt. Langfitt to F. L. Chambers, Dec. 20, 28, 31, 1901, *ibid.*; Capt. Langfitt to Chief of Engineers, Jan. 13, 1902, *ibid.*; Capt. Langfitt to J. J. Walton, Feb. 15, 1902, *ibid.*; Major James McIndoe to Chief of Engineers, Jan. 21, 1911, RG 77, NAS, PD, Entry 37, Box 3; Tweedell, *Millrace History*, 12-13; Lomax, *Later Woolen Mills*, 127-28.

¹² Minutes of the Chambers Power Company, 1906-1915, Frank L. Chambers Papers, Lane County Historical Society; see especially minutes for June 11, 1910, which proposed rip-raping or otherwise protecting the upper section of the raceway from encroachment by the river; *Eugene Daily Guard*, Oct. 6, 1910.

¹³Major James McIndoe to Mrs. W. F. Osburn, October 28, 1910, RG 77, NAS, PD, Entry 37, Box 3; Major James McIndoe to Mrs. W. F. Osburn, Dec. 8, 1910; Major James McIndoe to F. L. Chambers, Dec. 13, 1910, *ibid.*; Major James McIndoe to Chief of Engineers, Jan. 21, 1911, *ibid.*; Major James McIndoe to E. J. Frasier, Jan. 21, 1911, *ibid.*; Petition of Riparian Owners to the Officers and Members of the Eugene Commercial Club, Eugene Oregon, Jan. 13, 1911, Frank L. Chambers Papers, Lane County Historical Society.

¹⁴ *Eugene Daily Guard*, Jan 14, 1911; Major James McIndoe to Chief of Engineers, Jan. 21, 1911, RG 77, NAS, PD, Entry 37, Box 3; Major James McIndoe to E. J. Frasier, Feb. 9, 1911, *ibid.*

¹⁵ *Eugene Daily Guard*, quote in Jan. 17, 1911, see also, "Open Letter," *ibid.*, Jan. 17, 1911, *ibid.*, Jan. 13 and 14, 1911; *Morning Register*, Dec. 4 and 6, 1910, *ibid.*, Jan. 10 and 24, 1911, quote in Jan. 10.

¹⁶ *Eugene Daily Guard*, Aug. 12, 1910; Tweedell, *Millrace History*, 13-15; quotes from Rees, "The Millrace," 30, 74-75.

¹⁷ Tweedell, *Millrace History*, 14-15; Rees, "The Millrace," 30-31, 76; Lomax, *Later Woolen Mills*, 139; *Eugene Daily Guard*, Mar. 13, 1917. Jones maintains that even after 1928, "the two companies continued to use water to drive an electrical generator until flooding in 1944 rendered the Millrace unfit for any industrial use." Quote from Jones, "Industrial Uses of the Millrace," 12.

¹⁸ Tweedell, *Millrace History*, 9-11; Rees, "The Millrace," 26-27, 29, 31-38.

¹⁹ Although the city bought the mill property and water power easement in 1947, it has never exercised its right to use the flow in the millrace for the purpose of generating power. Since the millrace has not been used to generate power after 1928, it is possible that the easement may be considered legally abandoned. Rees, "The Millrace," 34-55, 76-85.

²⁰ Rees, "The Millrace," 37; George Kramer, Rick Minor, and Kathryn Toepel, An Archaeological Assessment of the Eugene Millrace Diversion Dam and Intake for the I-5 Willamette River Bridge Project, lance County, Oregon (Eugene, Heritage Research Associates Report No. 314, 2007), 7-11; "Millrace Crossroads," *Eugene Register Guard*, Nov. 21, 2009.

²¹ This description of the extant elements of the millrace and headworks and their probable construction chronology draws on Kramer, et al., 11-15; see especially the maps at 11 and 17.