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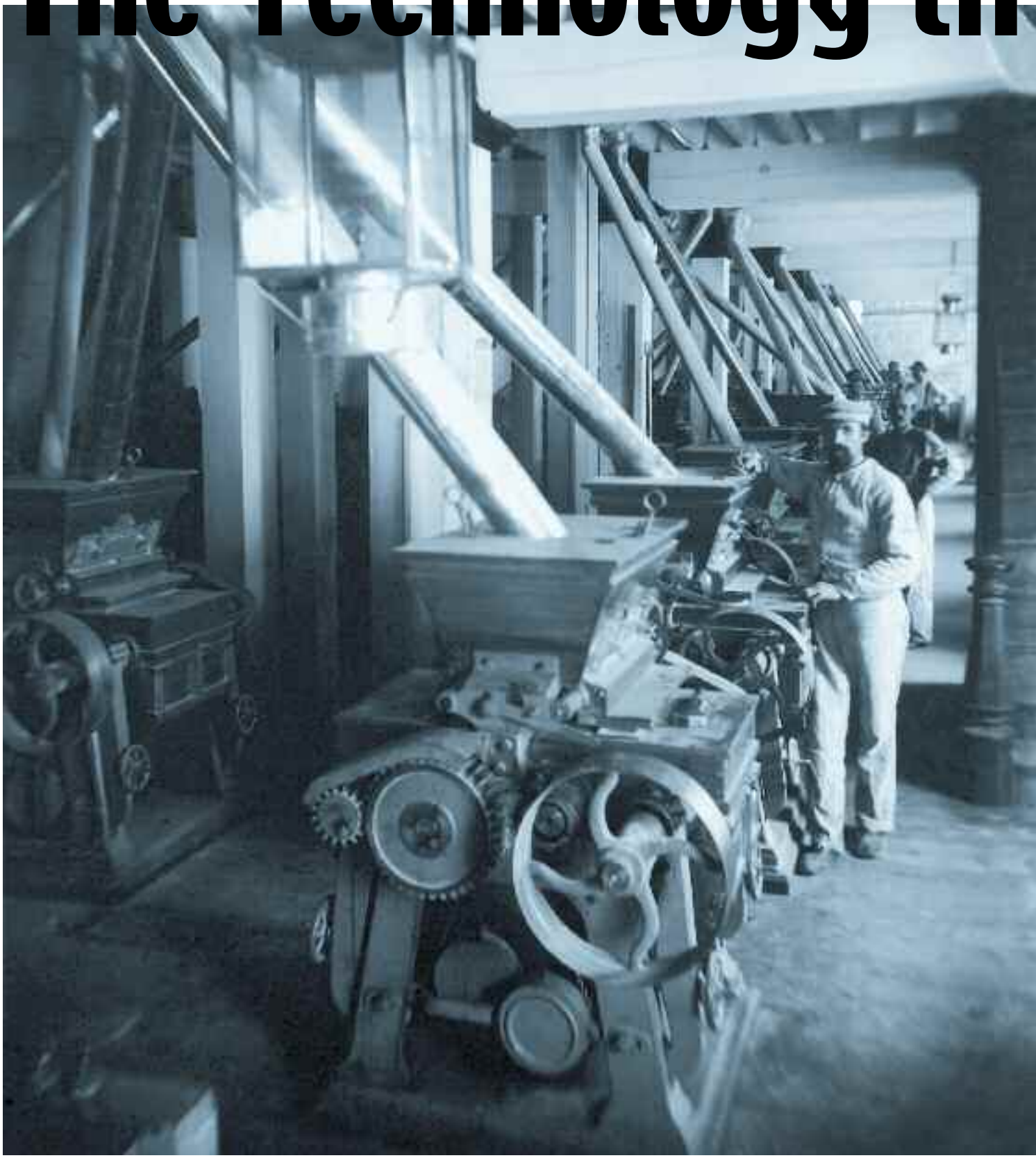


Men operating the Ohio-built roller mills inside the first Washburn A Mill, Minneapolis, about 1875

at Launched a City

Scientific and Technological Innovations in Flour Milling during the 1870s in Minneapolis

In 1999 the editors of **Minnesota History** *named Alison Watts the winner of a new prize, the magazine's publication award for the best senior-division History Day paper on a Minnesota topic. The award includes a $50 prize, the opportunity to be part of the publication process, and publication in* **Minnesota History.** *Watts, then a tenth grader at South High School in Minneapolis, selected her topic to fit the 1999 History Day theme of "Science, Technology, Invention in History: Impact, Influence, Change."*

History Day, a popular and highly regarded academic challenge—more than 500,000 students participated nationwide in 2000—is the fastest-growing social studies enrichment program in Minnesota. Its goal is to promote the study of history by engaging students and teachers in the excitement of historical inquiry and creative presentation in imaginative exhibits, original performances, media presentations, and papers.

Watts's paper appears here with the photographs she selected for publication. We hope that its thorough research, careful synthesis, and clear writing interest all readers and inspire future History Day participants.

Alison Watts

During the 1870s and 1880s several significant scientific and technological innovations were made to flour mills in Minneapolis. These developments greatly improved flour manufacturing and propelled the city into becoming the nation's leading flour producer. The middlings purifier, the gradual-reduction process, and the Berhns Millstone Exhaust System were the most important innovations during this time period. These three inventions, adopted by local flour millers, had great economic and social significance for both Minneapolis and the state of Minnesota. The evolution from Minnesota's first grist mills in the 1850s to the cutting-edge technology implemented by the 1880s, and the impact that this evolution had on different industries, is very important to the history of the state and the overall growth of the flour-milling industry.

According to one historian, "A fortuitous set of circumstances allowed Minnesota and especially Minneapolis millers to be at the very center of change and to build for themselves a powerful industry which would dominate American and world flour milling for the next half-century." One of the most important factors contributing to flour milling in Minneapolis was the water power supplied by St. Anthony Falls. The falls have been described as the "first and enduring impetus to the

growth of Minneapolis." Since the falls, situated on the Mississippi River, featured level banks and a great volume of water, the U.S. government built the first grist mill there in 1823. This mill supplied soldiers stationed at Fort Snelling with fresh flour; however, the bread was unsatisfactory and Minnesota developed a bad reputation for flour production that would last until the millers made technological improvements.[1]

Minnesota's flour-milling business remained very modest throughout the first half of the nineteenth century. Mills produced flour for lumbermen who worked the sawmills and for immigrants who arrived around the 1840s. These mills were unsuccessful and often failed since millers were using methods that had not changed for hundreds of years. Minnesota pioneers had adopted the old grist-mill pattern from the East Coast. The grist mills operated when water was poured over a wheel that turned a pair of large stones by way of a simple gearing system. The millstones were set close together and run at high speeds to produce as much meal as possible from a single grinding. This process, known as "low-grinding," produced acceptable flour from winter wheat, the staple cereal of eastern mills, but did not produce favorable results from the spring wheat grown in Minnesota. How millers responded to the problem of grinding spring wheat would affect not only the future success of flour production in Minneapolis but also the development of the city.[2]

Dressing or recutting the grooves in a millstone inside the Minnesota Flouring Mill on Hennepin Island, about 1858. The men in this daguerreotype are Francis and I. P. Hill.

Spring wheat was hard, red, and the only kind that could grow in Minnesota's climate. The softer winter wheat, which was milled into the desirable white flour with great success in the East, was preferred and worth much more than spring wheat. According to the Chicago Exchange, flour made from spring wheat sold for about a dollar less per barrel than the winter variety before 1870. There were many problems with milling spring wheat under the old grist-mill process. Winter wheat had a soft gluten layer, and its outer bran coat, which tended to stay whole throughout the grinding process, could be sifted out of the flour. Spring wheat had a more brittle bran husk, which shattered into fine particles that discolored, darkened, and speckled the flour. The moisture from the bran shortened the storage life of the flour, and the heat from the process impaired its quality. Consumers also complained that the oily interior of the spring wheat kernel (the endosperm) caused the flour to turn rancid. Spring wheat did, however, have a high gluten content, the nutritious wheat substance that gives dough elasticity. But the glutenous layer was too hard to be pulverized in a single grinding, so it was instead granulated into "middlings," which were sifted out of the flour. Hence, the most nutritious element and the ingredient that made baked goods rise was removed, resulting in inferior flour. Millers realized that they had to find a way to grind the gluten and endosperm together but also eliminate the bran. In order to do this, they would need to improve their milling methods. These difficulties in milling hard spring wheat served as a catalyst for Minneapolis millers to search for scientific and technological innovations that would improve their situation.[3]

Technological improvements introduced in the 1870s made Minnesota the largest flour producer in the country and provided the foundation for the development of the city of Minneapolis. The area's success in flour milling was attributed to "a technological

revolution . . . [that] made spring wheat flour the most desired of all such products, putting Minnesota and its millers in a fortunate position to serve the industry and giving Minnesota a name as 'the great spring wheat state.'" The tremendous milling expansion made Minneapolis flour the "most profitable product in the industry." The most important of these refinements were the middlings purifier, the gradual-reduction process, and the Berhns exhaust system.[4]

Cadwallader C. Washburn, the "father of modern milling in America"

The man who is largely responsible for the technological revolution and the importance of flour milling in Minneapolis is Cadwallader C. Washburn. He established one of the largest milling companies, solved product transportation problems, and found a wide market for the distribution of his product. Washburn's capital and business acumen, along with his ambition to lead the way in the development of the new technology, resulted in a revolutionized flour-milling industry. Washburn is spoken of as the father of modern milling in America because of his "flair for technological innovation that was to transform the entire American milling industry." Confronted with the problem of satisfactorily grinding spring wheat and determined to succeed in his milling ventures, Washburn generously financed many experiments involved with the milling revolution. A company booklet for children said that "Washburn-Crosby Company's experts have searched the world over for the latest and most improved methods, have studied scientific processes and applied this study and research to the construction and equipment of their enormous plant." According to business historian Don Larson, the Washburn family was "instrumental in pioneering several revolutionary changes in the U.S. flour milling industry, refinements of which were adopted by mills throughout the world."[5]

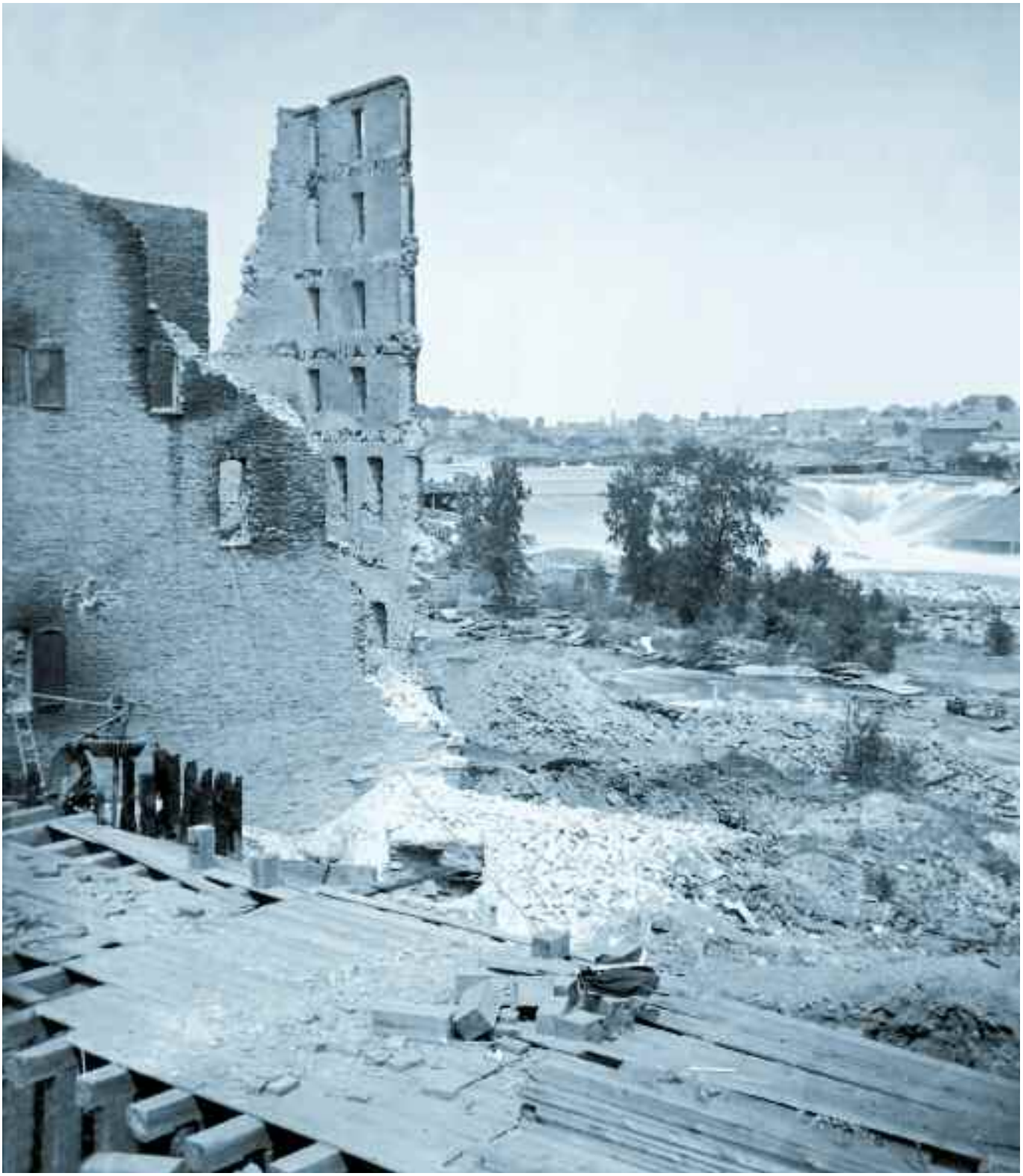
"A GREAT FLOURING MILL is a wonderful aggregation of delicate and ingenious mechanical processes," a magazine article once stated. If this is true, many great flour mills were developed as a result of new technology. One of these mechanical processes was the middlings purifier. The middlings purifier cannot be called the invention of any one experimenter. Instead, it came about as a result of contributions by many people. The middlings purifier was first invented in about 1860 by the Frenchman Joseph Perrigault, but the machine was greatly improved upon by Edmund La Croix under the direction of Washburn. George Christian, who worked for Washburn in 1870, had tried to experiment with the idea of a middlings purifier but needed help. He soon hired the La Croix brothers, French engineers who were also familiar with the purifiers that had been used experimentally in France since the 1860s. Christian and the La Croix brothers worked together in secret, and in 1871 the machine was installed in the Washburn B mill. One milling historian describes, in a simplified form, how the machine worked: "The wheat kernel passed through millstones set just high enough to break it up, cracking the hard center and separating the bran." He continues, "This meal was fed into the purifier on a vibrating sieve. Air blasts and suctions removed the light bran; larger and heavier impurities remained on the sieve, and the now-purified, white middlings passed through . . .[and were] put back through the millstones and reduced to flour." George T. Smith, who also worked for Washburn, continued perfecting the machine by devising an automatic traveling brush to keep the sifting cloth clean, putting air currents under more complete control, and developing a method that partially graded middlings. This machine became known as the middlings purifier and was to propel the flour-milling industry into a revolution of methods and machines.[6]

Washburn also contributed to another very important improvement in flour mills. In most mills at this time, sandstone millstones or the more advanced porcelain rollers were still being used to crush the wheat. This made milling difficult since sandstones were costly and time consuming to replace, and as they wore down, a fine grit would become mixed with the flour. Porcelain rollers tended to chip, wear unevenly, and produce an awful noise. Washburn was determined to overcome this difficulty and employed William de la Barre to help him complete the revolution in milling techniques.[7]

De la Barre was an Austrian engineer who became an important figure in Minneapolis flour milling. He

was familiar with some of the new European ideas but not with any technological details. Washburn decided to send de la Barre to Hungary in search of this new technology. The Hungarians were very secretive about their processes, and de la Barre had to disguise himself in order to take notes on their machinery. Soon after, de la Barre began planning new machinery to be installed in the Washburn A mill. The new machinery, based on the "Hungarian method," included interspaced steel rollers, which ground wheat into different grades of flour. In an advertisement from the time period, the new technique is called "improved because it requires less power, has greater capacity, and produces better results than the old style gradual reduction." This new method of gradual reduction soon completely replaced grist stones because the steel rollers could do more work with less power, lasted much longer, and yielded more flour. The innovation also prevented heat discoloration, minimized the crushing of the bran husk that speckled the flour, and utilized equipment that was easier to maintain than millstones or porcelain rollers.

The new technology designed by La Croix and de la Barre was implemented in Washburn's largest and most impressive mill, the A. This mill was thought to symbolize the dominance of flour in Minneapolis and the city's drive toward milling supremacy. But it only stood for four years before one of the city's most devastating tragedies took place. On the morning of May 2, 1878, the Washburn A mill exploded, killing 18 workers, destroying six other nearby mills, a railhouse, and several other stores—and stunning the entire city. There was a question whether Minneapolis would recover from the blow and continue on its path of milling dominance or "whether the explosion would mark the point at which the industry so important to the city lost its impetus for growth." This situation "brought scientists from all parts of these United States, as well as Europe, for the purpose of investigating and ascertaining, if possible, the causes which should produce such a terrible calamity." The cause was air combined with very fine flour dust, which could explode if ignited by a stray spark from a pair of millstones, for example. "Ironically," one source said, "the explosion and subsequent rebuilding allowed Washburn and others the opportunity to install the latest technology in their new buildings, thus propelling Minneapolis into nationwide dominance of the industry." According to another



Ruins of the Washburn A Mill after the May 1878 explosion, with the Falls of St. Anthony in the background

source, there would be no more explosions in Minneapolis: "Science and technology went to work upon the problem of their cause and cure."[8]

Once the cause was discovered, Washburn and associates went to work rebuilding his empire, only this time he installed the gradual-reduction method and steel rollers in all of his mills. A safer ventilation system that drastically reduced the amount of flour dust in the air, called the Berhns Millstone Exhaust System, was also introduced by de la Barre, a former Berhns company agent, as a way to prevent future catastrophes. The milling revolution was finally complete. The development of the middlings purifier, the gradual-reduction method with steel rollers, and the Berhns exhaust system now enabled Minneapolis to product flour faster, more safely, and more efficiently.[9]

The immediate and extended impact of the new technology was incredible. The improvements made over this time period "should not be seen as discrete developments, but together as a response to milling difficulties, and as a revolutionary synthesis born and nurtured first in Minnesota but soon spreading through mills everywhere," according to milling historian Robert M. Frame. Spring wheat became much more valuable than winter. More nutritious and yielding 12 percent more bread per given amount, it became

Prosperous, rebuilt milling district, about 1918, seen from Minneapolis's Washington Avenue. The Washburn-Crosby complex stretches from left to the 1906 grain elevators at right; in the foreground is the trestle that carried railroad tracks across Washington Avenue.

Containers of samples on the crowded Minneapolis Grain Exchange trading floor, about 1900

recognized as high quality—the best in the world. By the 1880s the new technology was in common use all over Minneapolis and the milling revolution was complete. Washburn had, by "championing the development of new techniques transformed a trade into a science." The milling revolution "wrote finis to the primitive practices that had endured for centuries and opened the modern chapter." In the end, the milling revolution was described as "the combined brains of many men, working on the practical application of an already established principle, produc[ing] a machine which revolutionized milling . . . and profoundly affected the economy of the Midwest."[10]

The expansion of the flour-milling industry after the development of the new technology was miraculous. Not only were 17 huge flour mills built between 1870 and 1880, but Minnesota flour prices rose from $.50 profit per barrel in 1871 to $4.50 in 1874. Minnesota flour output rose from 850,000 barrels in 1875 to 7 million barrels in 1889. In 1880 Minneapolis replaced St. Louis as the nation's leading flour producer. Sawmills had all but disappeared from the falls areas by 1889, and Washburn's three brands of flour took gold, silver, and bronze medals at the Millers' International Exhibition in 1880, a testimony to the impact of the new flour-mill technology on both the city and the state.[11]

The scientific developments also influenced the perception of Minneapolis. One magazine claimed, "It is a pleasure to become acquainted with a city that owes its growth and prosperity to the manufacture of a good, honest article and to the earnest efforts to improve the quality of that article so as to make it the best of its kind to be found in the markets of the world. Such a city is Minneapolis." The source went on to say that the development of Minneapolis "from an obscure village to a handsome, busy, energetic town is . . . chiefly [due] to its flour-mills." Minneapolis developed around its flour mills. "As the St. Anthony Falls industrial district grew, so did the city of Minneapolis," another source said. In 1860 the population of Minneapolis was 5,809; by 1885 it had grown to 129,200. Technological advances in flour milling clearly led to the growth and development of Minneapolis.[12]

Flour milling affected other aspects of Minneapolis, as well. Many marketing schemes were developed as a result of the booming industry. In 1876 the Minneapolis Millers Association was formed to establish pricing rules and to buy and distribute wheat to mills. The Minneapolis Chamber of Commerce was formed in 1881 by merchants who bought wheat for eastern mills and soon took over the Millers Association.

Rail service to the rebuilt Washburn A Mill on the Mississippi's west bank, about 1882

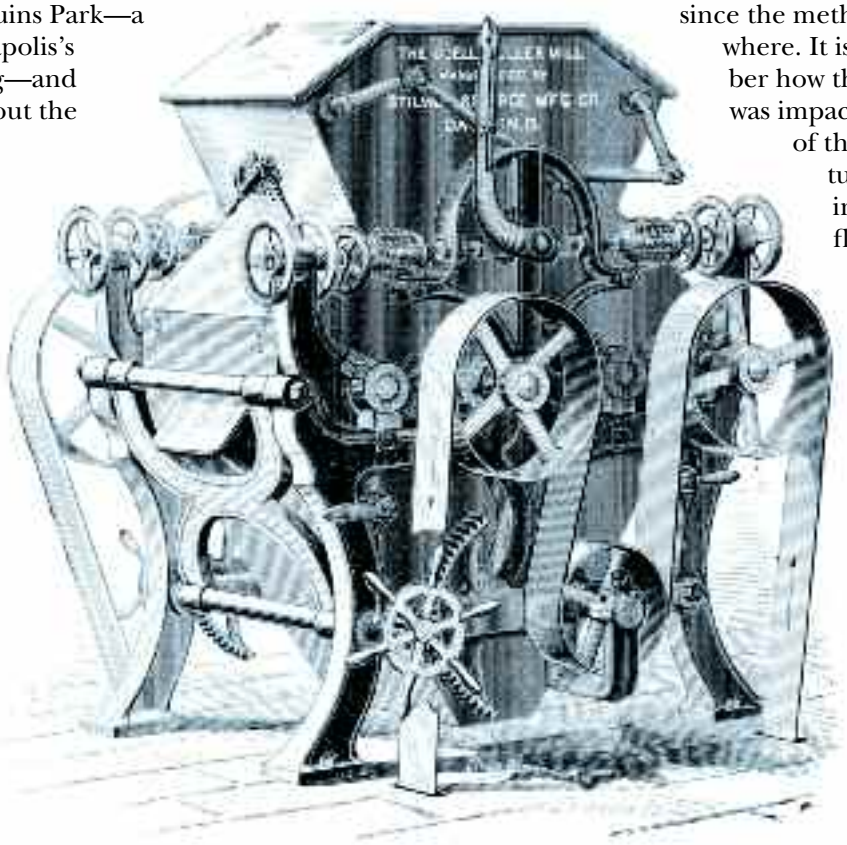
Consolidation of flour milling took place as giant corporations such as Pillsbury-Washburn and Washburn-Crosby (General Mills) were established.[13]

Minneapolis millers also greatly affected transportation in the state. Since the millers were forced to depend on railroads in Chicago, they sought alternative shipping methods. At first, Lake Superior provided a route to the East, but this passage could only be used in the summer. In 1873 Governor Israel Washburn of Maine (Cadwallader's brother) suggested the development of a new train system. This line would free Minneapolis from Chicago dominance, provide a shorter route to the Atlantic Coast, and open rich territory in surrounding states. This suggestion resulted in the success of the Soo Line, which was completed in 1888 and exported more flour than any other railroad during this period. Minneapolis millers also contributed to other railroad projects that would improve their sales. As one historian said, "In the growth of the Twin Cities as a railroad center, the Minneapolis milling business was a prominent factor; and in the cases of the Soo line and the Minneapolis and St. Louis, the millers had a dominant part . . . and benefited directly by their success."[14]

There are still more ways in which the development of new milling technology impacted the city of Minneapolis. "When an industry develops to the size and importance of Minneapolis flour milling," one source said, "it is bound to affect, in some degree, almost all the other industries of the city." Some examples are the bag and barrel factories that took hold during the 1870s (Minneapolis led the nation in bag production); the manufacturing of milling machinery; and the production of biscuits, crackers, and breakfast cereal by firms such as the Pettijohn California Breakfast Food Company, established in 1893 (later absorbed by Quaker Oats), and the Cream of Wheat company, which located in Minneapolis in 1897. Due to the many mill hazards, artificial limbs became a homegrown industry, with six local manufacturers of prostheses competing for business.[15]

The owners of flour mills also contributed to society by holding large amounts of stock in banks and railroads, and they played a prominent role in religious, social, charitable, and cultural organizations. To serve the growing community, stores, schools, churches, and a hotel were built, and hundreds of laborers and professionals moved in. By 1880 doctors, bankers, lawyers, teachers, merchants, and others were drawn to the thriving community. Minneapolis had evolved into a cultured and prominent city as a direct result of the technological developments in the flour-milling industry.[16]

Minneapolis reigned as the nation's leading flour producer until 1930. Soon after, many of the prominent companies left the Minneapolis area for places like Buffalo, New York, and many of the mills that had once had all the cutting-edge technology were demolished. Some of the old mills, like the rebuilt Washburn A, have stood in ruins for the last 30 years or so. But there is a new movement to restore this area and turn the old mills into a small community. The community will have condos and shops but will focus around Mill Ruins Park—a memorial to Minneapolis's roots in flour-milling—and a major museum about the history of the area.[17]



The effects of the innovations made to flour milling during the 1870s are startling. Spurred by the inefficiency of old gristmill methods, Minneapolis millers, influenced by European engineers, were able to implement three very important technological innovations to flour milling. The middlings purifier, the gradual-reduction method, and the Berhns exhaust system impacted the way millers marketed grain, influenced railroads, and served as a catalyst for the growth of Minneapolis. These developments are significant not only for the city where they originated but for the entire world, since the methods were used everywhere. It is important to remember how the city of Minneapolis was impacted by the motivation of the millers and how, in turn, their technological innovations have influenced flour milling the world over since the 1870s. ❑

Preserving the ruins of a National Historic Landmark, the Minnesota Historical Society plans to open the St. Anthony Falls Heritage Center inside the rugged shell of the Washburn-Crosby A Mill in late 2002. In the heart of Minneapolis's milling district between Second Street and West River Parkway, the heritage center will feature exhibits about flour milling, water power, railroads, and how the region's economic growth and immigration patterns were influenced by the river and its industries. Many features of the original mill will be left intact, including flour bins, milling machinery, the engine house, rail corridor, and wheat house.

Mill Ruins Park—a Minneapolis Parks Board development highlighting the milling district's history through exposed foundations and reconstructed raceways—is being developed on the river side of the complex.

NOTES

1. Robert M. Frame III, "The Progressive Millers: A Cultural and Intellectual Portrait of the Flour Milling Industry, 1870–1930" (Ph.D. diss., University of Minnesota, 1980), 38; Eugene V. Smalley, "The Flour-Mills of Minneapolis," *Century Magazine* 32 (May 1886): 38; William R. Fieldhouse, "History of the Flour Milling Industry of Minneapolis" (master's thesis, University of Minnesota, 1916), 1–2; Robert M. Frame III, "Millers to the World: Minnesota's Nineteenth-Century Water Power Flour Mills," report, 1977, p. 15, copy in Minnesota Historical Society Library, St. Paul.

2. "Historical Sketch of the Great Minneapolis Water Power," *Northwestern Miller,* Aug. 22, 1879, p. 121; James Gray, *Business Without Boundary: The Story of General Mills* (Minneapolis: University of Minnesota Press, 1954), 17; Joseph Hart, "The Lost City," *City Pages* (Minneapolis), June 11, 1997, p. 17; *Saint Anthony Falls Rediscovered* (Minneapolis: Minneapolis Riverfront Development Coordination Board, 1980), 36.

3. Gray, *Business,* 17; William E. Lass, *Minnesota: A History* (New York: W. W. Norton, 1977), 133; *Saint Anthony Falls Rediscovered,* 36; Frame, "Progressive Millers," 40; Lucile M. Kane, *The Falls of St. Anthony: The Waterfall that Built Minneapolis* (1966; reprint, St. Paul: Minnesota Historical Society Press, 1987), 105.

4. Gray, *Business,* 4; *Saint Anthony Falls Rediscovered,* 35.

5. Gray, *Business,* 5; Lass, *Minnesota,* 133; Smalley, "Flour-Mills," 41; *Saint Anthony Falls Rediscovered,* 51; *Wheat and Flour Primer* (Minneapolis: Washburn-Crosby Co., n.d.), 9; Don W. Larson, *Land of the Giants: A History of Minnesota Business* (Minneapolis: Dorn Books, 1979), 66.

6. Smalley, "Flour-Mills," 42, 45; Gray, *Business,* 19; Lass, *Minnesota,* 134; Frame, "Millers," 51; "The Early History of New Process Milling—IV," *Northwestern Miller,* Sept. 14, 1883, p. 248.

7. Here and below, Lass, *Minnesota,* 135–36; Larson, *Land of Giants,* 67; Gray, *Business,* 21–22; William C. Edgar, *Medal of Gold: A Story of Industrial Achievement* (Minneapolis: Bellman, 1925), 106; advertisement, *Northwestern Miller,* Sept. 7, 1883, p. 231; Kane, *Falls of St. Anthony,* 105.

8. Kane, *Falls of St. Anthony,* 102, 103; Lucile M. Kane and Alan Ominsky, *Twin Cities: A Pictorial History of Saint Paul and Minneapolis* (St. Paul: Minnesota Historical Society Press, 1983), 46; R. J. Taylor, *The Washburn Mill: A Complete Solution of the Mysterious Causes of the Blowing Up of the Washburn Mill* (Galesburg, IL: Galesburg Printing, 1880), 1; S. F. Peckham, "The Dust Explosions at Minneapolis, May 2, 1878, and Other Explosions," pamphlet, reprinted from *Chemical Engineer,* Mar., Apr., May 1908, p. 7; Robert M. Frame III, "The Minneapolis Horror: The Great Mill Explosion of 1878," *Old Mill News* 6 (Jan. 1981): 9; Smalley, "Flour-Mills," 42.

9. *Saint Anthony Falls Rediscovered,* 52; Larson, *Land of Giants,* 68.

10. Frame, "Progressive Millers," 38; Kane, *Falls of St. Anthony,* 105; Lass, *Minnesota,* 134; Smalley, "Flour-Mills," 37; Gray, *Business,* 17, 19, 24.

11. *Saint Anthony Falls Rediscovered,* 35; Gray, *Business,* 20, 28, 36; Kane and Ominsky, *Twin Cities,* 46; Kane, *Falls of St. Anthony,* 115.

12. Smalley, "Four-Mills," 37, 38; Hart, "Lost City," 18.

13. Kane, *Falls of St. Anthony,* 101; Charles B. Kuhlmann, "The Influence of the Minneapolis Flour Mills Upon the Economic Development of Minnesota and the Northwest," *Minnesota History* 6 (June 1925): 148; Kane and Ominsky, *Twin Cities,* 81.

14. Gray, *Business,* 27–28; Kuhlmann, "Influence," 145–46.

15. Kuhlmann, "Influence," 151–52; Hart, "Lost City," 20.

16. Kane, *Falls of St. Anthony,* 98–99.

17. Victor G. Pickett and Roland S. Vaire, *The Decline of Northwestern Flour Milling,* Studies in Economics and Business, no. 5 (Minneapolis: University of Minnesota Press, Jan. 1933), 16; Hart, "Lost City," 16.

All illustrations, including the roller-mill ad from Northwestern Miller, *Apr. 6, 1883, p. 321, are in MHS collections.*