

Country and City Mills

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In

Early American Flour Manufacture and Export

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“I hope, someday or another, we shall become a storehouse and granary for the world”
George Washington, 1788

Introduction: It has been over 75 years since the last comprehensive description of the American flour industry was published. Since the 1929 publication by Kuhlman¹, Americans have taken increasing interest in their historic mills, but have lost sight of the evolution and growth of the flour manufacturing and export industry during the first 220 years of our republic. Most current mill enthusiasts are unaware of the important role the American flour milling industry played in the industrial revolution prior to the beginning of our Civil War in 1860. Describing this history is made difficult by the limitations of data. There was no government agency that continued to track economic activity until after the Civil War. There is no single source of flour production, inspection, and export data for the various states and cities for the years leading up to 1860. Nonetheless, a good picture can be pieced together from the many sporadic sources. Many of these sources are listed in the bibliography at the end of this article. These sources fall into a few categories:

1. Published histories of American manufacture from 1854², 1868³, 1881⁴, 1916⁵, 1929⁶ and 1979⁷.
2. Journals of foreign travelers to early America such as that of Rouchefoucauld⁸, who visited American flour mills from 1795-1797, and Ganzel & Wulff⁹ who visited many mills in the mid-Atlantic region from 1827-1829.

¹ Kuhlmann, Charles B. *The Development of the Flour Milling Industry in the United States* (New York: Houghton Mifflin, 1929, Chapter II)

² DeBow, J. D. B. *The Industrial Resources, Statistics of the United States* (Volume I, New York: D. Appleton & Co., 1854)

³ Bishop, J. Leander, *A History of American Manufactures from 1608-1860* (Volume I, New York: Augustus M. Kelley, 1966)

⁴ Bolles, Albert S., *Industrial History of the United States*, 3 ed, 1881 (New York: Augustus M. Kelly, 1966)

⁵ Clark, Victor S. *History of Manufactures in the United States* (Volume I, 1607-1860, New York: McGraw Hill, 1916)

⁶ Kuhlmann, loc. cit

⁷ Hunter, L., *A History of Industrial Power in the United States, 1790-1930*, (University Press of Virginia, 1979)

⁸ La Rochefoucauld-Liancourt, *Travels through the United States of North America* (London 1799)

⁹ Beuth, Ganzel, & Wulff, *Contributions to the Study of the American Milling System and Flour Production*, (Berlin 1832)

3. Histories of flour manufacture in specific cities, such as Baltimore¹⁰¹¹, Rochester¹², or Richmond¹³.
4. Government reports that cover flour manufacture.
5. Business newsletters including data on flour manufacture; publications by historians; internet web pages.

The First Mills in Colonial America:

Bishop¹⁴, in his historical summary of American manufacturing, provides a summary of early mills. The first mills in Colonial America were no doubt hand mills that were easily transported in the small sailing ships that brought the first Europeans to America. The Native Americans that occupied the land had their own hand tools for turning their corn into a more digestible meal. Unlike the Native Americans, the early colonists understood 17th century European milling technologies and wasted little time in harnessing the energy of the available water, wind, and animal power.

The first mill in New England was built in 1632 and was a wind-mill near Watertown. This mill was moved in the same year to Boston, perhaps illustrating the understandable trial and error approach of the first arrivals. This mill was the first known attempt in early America to use the wind to supersede the mortars and hand mills that were first used by the people.

The first mill in New York, at the Dutch settlement on the Manhattan Island, was a horse-mill, built in 1626. As in New York, so in New Jersey, horse mills were first used to replace the primitive and laborious hand-mills.

In Maryland, the first water-mill for corn was erected, by public subscription, in 1639. The famous large mill-sites, near Baltimore on the Patapsco River, were built about the year 1763 by Joseph Ellicott and J. & H. Burgess, from Bucks County, Pennsylvania. Virginia, in 1649, had in operation four wind-mills and five water-mills.

During the 17th century, wind and animal powered mills proved insufficient for the manufacture of flour on a scale commensurate with the needs of the expanding population. The extensive available water privileges were rapidly harnessed as the superior motive power. The early water powered mills were of a small scale on small streams. The streams were unreliable and the construction was frequently poor since highly skilled craftsman were in short supply; little physical evidence remains of the existence of these mills. In the 18th century, larger and well constructed mills began to appear at locations with reliable water supply and favorable transportation resources. The mills on the Patapsco are a prime example.

¹⁰ Sharrer, G. Terry, "Flour Milling in the Growth of Baltimore", *Maryland Historical Magazine* 71: 3 (Fall 1976) 322-333

¹¹ Sharrer, G. Terry, "The Merchant Millers: Baltimore's Flour Milling Industry, 1783-1860", *Agricultural History*

¹² Everts, Ensign, & Everts, "History of Monroe County", 1877

¹³ Berry, Thomas S., "The Rise of Flour Milling in Richmond", *The Virginia Magazine* 78: 4 (Oct 1970), 387-408

¹⁴ Bishop, loc cit

Country and City Mills:

The great majority of merchant mills built before 1860 were single isolated mills built on small streams that provided adequate and reliable power. These country mills had a capacity to produce up to 50 barrels of flour in a single day. In addition to these country mills, there were clusters of larger mills in cities with larger rivers and canals. These city mills manufactured flour on a larger scale.

Following the forming of the new government in 1788, the republic entered a period of spectacular economic growth. This growth was fueled by dramatic increases in population, expanding markets in the Caribbean and South America, unbounded entrepreneurial spirit, and great natural resources. The expanding flour manufacturing grew out of these conditions. America had an abundance of water power, adequate transportation infrastructure, the inventiveness of Oliver Evans¹⁵, vast regions for the growing of cereal grains, and a growing community of experienced millers.

The American inventor, Oliver Evans, 1755-1819 made significant contributions to the advance of milling technology during his life time. Evans innovations are described in his book, "The Young Mill-Wright and Miller's Guide", first published in 1795, and in the definitive biography, "Oliver Evans: A Chronicle of Early American Engineering" by Greville & Dorothy Bathe published in 1935.

Evans' inventions were granted a patent by the US Congress in 1791. Today Evans is given full credit for conceiving the first complete, systematic process of flour making by automatic machinery. These ideas were reflected in the great flour mills of the Mid-Atlantic region. Oliver Evans was one of the first persons elected to the American Inventors Hall of Fame. President Washington, before his death in 1799, recognized the economic benefits of Evan's ideas by installing his system in his mill at Mt. Vernon.

In the same year, 1799, the journal by La Rochefoucauld-Liancourt¹⁶ was published in London. In his travels in America, from 1795-1797, Rouchefoucauld visited several major milling centers. He visited two mills at Richmond, Virginia that were below the falls of the James River. One of these mills, using the great power of water, had six pairs of stones. He described it as a fine mill that unites the advantages of all the new inventions, but ill constructed, "the cogs of the wheels being clumsily executed." His observation about the quality of craftsmanship reflects the fact that labor, particularly skilled labor, was often in short supply.

Rouchefoucauld also visited the town, now known as Ellicott City, near Baltimore and recorded that "Ellicott's Mill is a small village, the principal establishment of which is a large grist-mill belonging to Mr. Ellicott". This mill had six pair of mill-stones, and Rouchefoucauld described it as constructed, "as well as any of the mills of the Brandywine." The Brandywine is the river at Wilmington, Delaware and the location of some of the most advanced mills at the end of the 18th century.

He recorded that all the operations of the (Brandywine) mills were performed by water, from the unloading of the sloops that brought the grain, to the finishing of the flour. He

¹⁵ Bathe, Greville and Dorothy, *Oliver Evans, A Chronicle of Early American Engineering*, (1935)

¹⁶ La Rochefoucauld-Liancourt, loc cit

said that the flour was sifted, ground, and bolted, without the least manual labor. Rouchefoucauld observed that “the mills are similar to those at London---. At London the flour when ground falls into troughs, and afterwards is conveyed by the laborers to other parts of the mill, where it is spread and turned by hand to cool before it is taken to be bolted--at Brandywine the flour falls as it is ground upon a wooden roller, armed with little detached wings, which are so arranged as to form a screw. The roller, fixed in a trough, is inclined towards a bin in such a manner that it serves as a conductor to the flour. A chain of small troughs, about three or four cubic inches long, dips into the bin, which receives the flour. This chain is enclosed in long perpendicular wooden cases. It turns upon two pivots; one -- in the bin --; and the other on the fourth floor, where the same little troughs empty themselves. The flour, conveyed by these troughs, falls on an inclined circular floor,-- it is there spread by a rake as large as the floor, the teeth of which are so placed as to conduct the flour towards the holes in the floor.”

This mechanism for conveying the flour from the mill-stone to the bolter was one of the many inventions of Oliver Evans.

The proprietor of one of the Brandywine mills examined by Rouchefoucauld was a Quaker by the name of Tatnall. Tatnall purchased the needed grain in Virginia, Maryland, and New York and brought it to his mill in his own ships. After being converted to flour, it was carried back to Philadelphia, in the same ships, where it was sold for exportation. This single mill produced about 20,000 barrels of flour yearly. The whole labor of the mill was performed by six men; whose chief employment was to place the flour in barrels. There were 24 other men employed for manning the ships and making the barrels.

From these on-the-scene observations, it is clear that by 1795, merchant mills were in place and the ideas of Oliver Evans were taking hold. Greville and Dorothy Bathe, in their biography of Evans¹⁷, note that George Washington “made a special point of calling at the Tatnall flour mills on the Brandywine. This visit was to thank Tatnall for his patriotic service in staying by his millstones during the Revolutionary War and grinding corn for the Continental army in the face of great danger and difficulty.” Tatnall, a year or so before this date, fitted out one of his mills with Evans’ improved milling machinery, and Washington, who was about to install the same improvements in his Mount Vernon mill, must have been very interested in observing the machinery in practical operation.¹⁸

New mills were being built at an exponential rate. In 1810¹⁹, America had over 2,900 water powered mills; in 1840²⁰ over 4,300 mills; in 1850 over 11,800; and in 1860 over 13,800 mills. In 1810, Pennsylvania, the leading flour manufacturing state, had over 2000 mills and Virginia, the second largest, had 441 mills. In 1810, Pennsylvania produced about one half of the manufactured flour; Virginia produced about one quarter. Two of the most productive counties in Virginia in 1810 had over 100 mills; only about 10

¹⁷ Bathe. loc cit

¹⁸ Pogue, Dennis & Bashore, Steven, “George Washington Gristmill and Distillery: Open for Business”, *Old Mill News* 31:3 (Summer 2007)

¹⁹ Coxe, Tench, *Arts and Manufactures of the United States of America, for the year 1810* (Philadelphia: A. Cornman, 1814)

²⁰ Bolles, loc cit

remain as intact buildings today, only two are operational. The Colvin Run Mill²¹, one of the very few remaining restored operating mills was built in 1809, on speculation by a developer. Two years later, in 1811, it was sold to a young experienced miller from Maryland, Philip Carper, and was a source of the growing wealth of the Carper family.

Fifty years later, there were almost 14,000 mills in America. The great majority of mills, like the Colvin Run Mill, were in the country where the conditions of ample water power and transportation were available. Some cities, at the fall line of major rivers where substantial water power and canal transport were in place, built large concentrations of mills to participate in the growing flour export business, (see the map of Mid-Atlantic canals in the Appendix). Examples of such city mills were at Rochester, Oswego, and Buffalo New York, Baltimore Maryland, Richmond Virginia, and Philadelphia Pennsylvania. Philadelphia had 30 mills in 1860 and Rochester 24. Richmond had a small number of very large mills with annual production similar to Rochester and Philadelphia. Today, the city mills have passed from the scene. All of the surviving mills, in the Mid-Atlantic region, are country mills.

The city mills were merchant mills oriented to the flour export industry and with a capacity of producing 50 to over 500 barrels of flour a day. The port cities in this export industry were numerous; New York, Philadelphia, Baltimore, and Alexandria and Richmond were the leaders in the Mid-Atlantic area during the years leading up to the Civil War, 1861-1865. After 1865, the center of the flour manufacturing and export industry had moved to St. Louis and Minneapolis with New Orleans as a leading port.

Examples of City Mills: Baltimore, Rochester, and Richmond

There were a few major urban milling centers in the first half of the 19th century. Philadelphia was the leader during the first years of the new republic. The center of manufacturing, inspection, and export moved west from Philadelphia to Baltimore where, by 1795, the Ellicott's had installed large mills based on the ideas of Oliver Evans. By 1800, the Baltimore area had about 50 merchant mills²². Baltimore city had 22 mills by the 1850's.²³ In 1860, Baltimore city had 41 of the 420 flour mills in Maryland. By 1815, Baltimore had replaced Philadelphia as the leading inspection and export center and held this position until 1826. The opening of the Erie Canal in 1827 made New York City the leading flour inspection and export center. Flour milling was Baltimore's first important manufacturing industry as it was for the Mid-Atlantic region.

Urban milling in Richmond, Virginia and Rochester and Oswego New York expanded with the opening of canals at the fall line where these cities were located. The James River Canal at Richmond opened in 1795, and the Erie Canal at Rochester opened in 1823. In 1850 Richmond, there were mills housing about 80 stone pairs with a capacity of over 400,000 barrels a year. At Rochester by 1850, there were about 20 mills housing 100 stone pairs with a capacity of 800,000 barrels a year. The mills at Oswego, New York were similar in number and capacity to those of Rochester.

²¹ Netherton, Ross, *Colvin Run Mill* (Fairfax, Virginia, Fairfax County Office of Comprehensive Planning, 1976)

²² Sharrer, loc cit

²³ Hunter, loc cit

Between 1809 and 1818 there were three large flour producers in Richmond²⁴: Gallego upstream on the canal, Rutherford (later, Cunningham) below Gamble's Hill, and the Haxalls at the foot of 12th Street. These mills can be located on the map of Richmond that is in the Appendix. Berry estimates that they jointly produced from 75,000 to 125,000 barrels per annum during the 1810 period. Well before the end of the eighteenth century, Virginia had an annual surplus of wheat of about 700,000 bushels or about 140,000 barrels of flour. By the time of the Civil War, the joint annual production of the Richmond mills was over 400,000 barrels. The first Gallego Mill was no doubt the mill visited in 1795 by Rouchefoucauld. By 1860, Gallego had moved his mills to the foot of the turning basin on the canal at 12th Street; at this location he had what was described as the largest flour mill in the world with 31 pairs of stones and an annual capacity of 200,000 barrels. In the 1850's, San Francisco reported receiving some 743,000 barrels of flour, virtually all ground in the Gallego or Haxall mills.

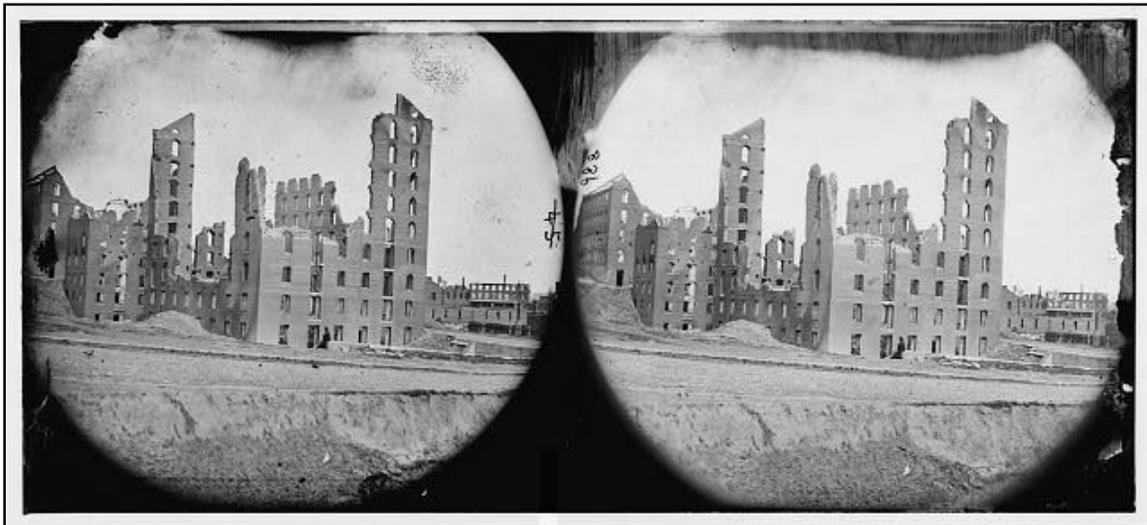
The James River Company's canal played an important role in the early development of milling by providing a power supply protected from droughts and floods. The main waterway was roughly parallel to Ross's canal; these features are evident on the map in the Appendix. Some sections were open to travel as early as 1789. The canal was about 90 feet above the elevation of the James River.

Before 1861, Richmond milling was dominated by a very few concerns. It was a lumber business as well as a grain business, since the product had to be packaged in barrels sound enough to withstand long sea voyages.

The largest and most successful of the Richmond mills were the Gallego Mills. The following is from Berry who reproduces an article from the 1865 Richmond newspaper.

²⁴ Berry, loc cit

Photo 1 Gallego Mills Ruins After the Fire-1865



“THE GALLEGO MILLS. - We take from the columns of this paper, published before the war, a description of the last erected portion of the Gallego Mills, which will be read with additional interest, now that blackened walls are all that remain of the once magnificent fabric. The building described, was one of three, composing together the Gallego Mills, the flour turned out by which was known over the whole world, and commanded in Rio and Australia a dollar a barrel more than any other American brand. We quote:

Richmond can boast of having within its limits the largest flouring mill in the world. The erection of the mill was regularly commenced some time in 1854. The superstructure rests upon a solid foundation of granite, the base of which is seventeen and a half feet thick. The width tapers to a thickness of six feet at the top of the granite. The average thickness of the brick walls, forming the first four stories above Canal Street, is three feet two inches. The great mill is twelve stories in height, fronts ninety-six feet on Canal Street, and is one hundred and sixty-five feet deep. The height of the front wall is one hundred and twenty-one feet to the top course of bricks. Including the observatory the total height is one hundred and thirty-five feet. The rear wall, embracing a part of the granite foundation, is one hundred and fort-seven feet high. Each floor contains 155,000

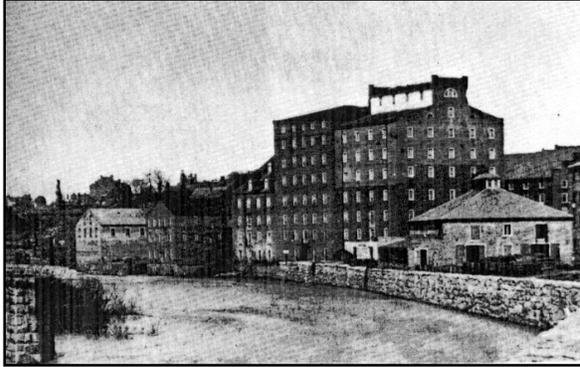
square feet. --- We have no positive information on the cost of this immense structure, but presume that the sum will not fall short of \$130,000.”



The Gallego name was associated with the commercial manufacture of flour from 1798 to 1930. Gallego’s first mills were located on the James River Canal about three miles west of the downtown turning basin of the Canal. The Gallego Mills moved to the east side of the turning basin and began the spectacular expansion, culminating in the 12-storey mills that

Photo 2 Gallego Mills Waterwheel after the Fire 7

were in place by 1854. In 1855, the mills had a capacity of almost 200,000 barrels a year and employed about 100 persons of which about 70 were slaves. The 12 story mills with their 31 stone pairs and 6 large waterwheels were destroyed by the 1865 fire set by the retreating Confederate Army.



The Haxall Mills on the river below the canals were a close second in size and production to the Gallego Mills. These mills were rebuilt in 1831 after the destructive fire of 1829. In 1860, the annual capacity was about 160,000 barrels. In 1850, these mills had 65 employees, 22 stone pairs, and an annual production of 100,000 barrels.

Photo 3 Haxall Mills from the James River-1865

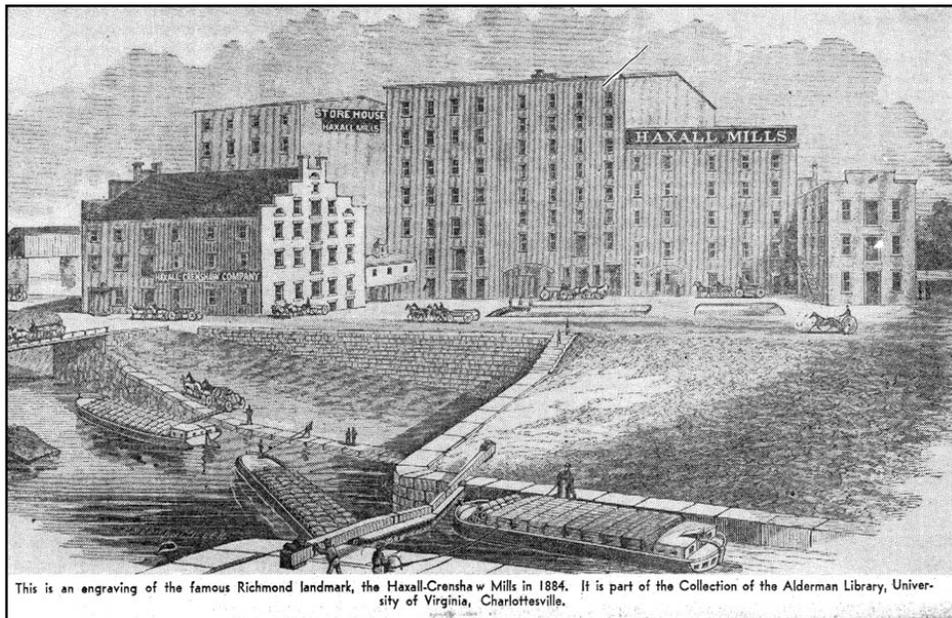


Photo 4 The Haxall Mills from the Canal Side-1884. From the Valentine Museum

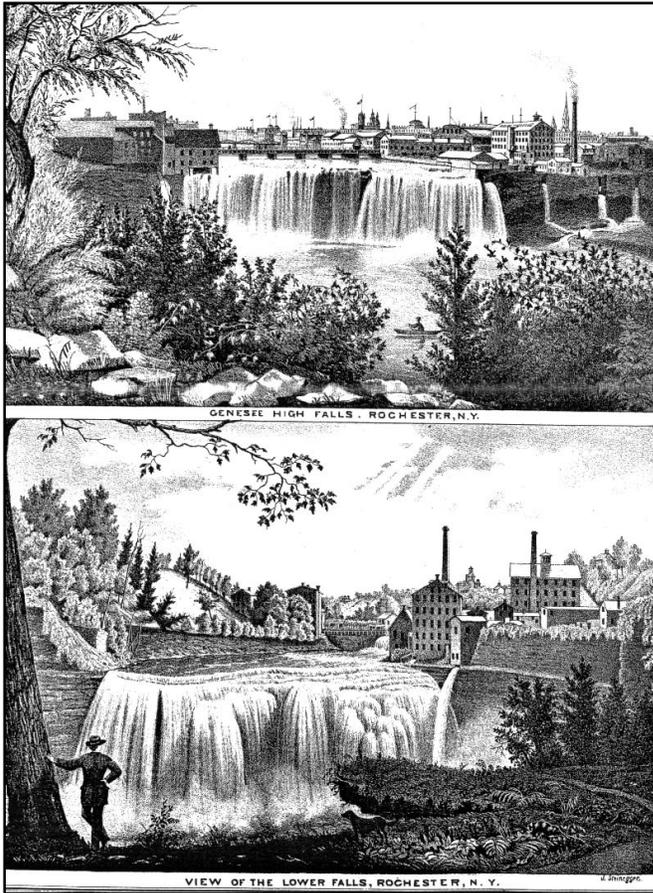


Photo 5 Mills of Rochester on the Genesee River

Rochester Mills²⁵

The mills at Rochester are described in the 1880 history of Monroe County. In 1850 there were about 20 mills along the canal and at the falls of the Genesee River. The largest had 10 stone pairs; the average was 5 stone pairs. The first flour for export was manufactured in 1814. In the year 1835, 18 mills manufactured about 460,000 barrels of flour. By 1870 these mills were capable of manufacturing 5000 barrels of flour daily.

Prices for grain and flour fluctuated dramatically and disastrously during this period due to weather, market supply and demand factors. The price of wheat in the national market at Philadelphia varied from a low of \$0.44 per bushel in 1826 to highs of \$2.50 in 1816 and \$2.15 in 1837. Growing grain and manufacturing flour was a risky business. At times, the British market was a stabilizing factor.

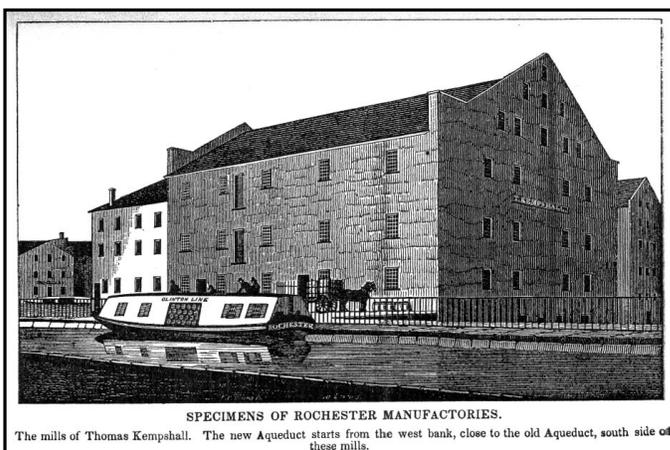


Photo 6 Mills of Thomas Kempshall at Rochester

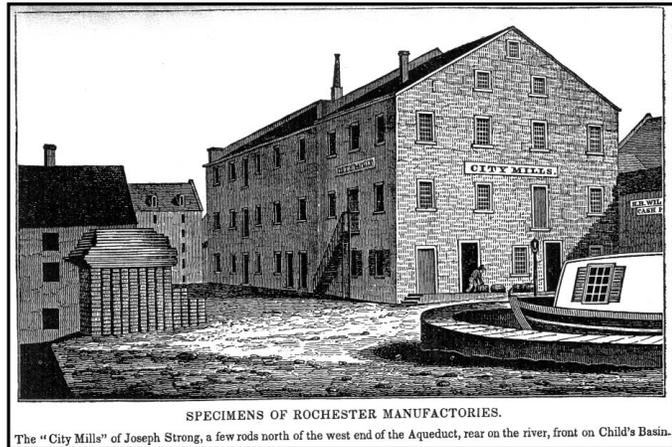
Export of flour from New York followed a pattern similar to that in Alexandria, Virginia. In 1760, New York exported less than 80,000 barrels; Alexandria, Virginia exported a similar amount. And, as in Virginia in 1785, the New York Legislature passed a law requiring the rigid inspection of flour.

It will be useful to describe three of the twenty Rochester mills to provide a more complete understanding of the Rochester

²⁵ Monroe County Historians, *History of Monroe County, New York* (Philadelphia: Everts, Ensign, & Everts, 1877)

industry. A quote from the 1877 text, *History of Monroe County*, is informative: “In 1827, E. S. Beach, T. Kempshall, and Henry Kennedy erected mills with ten pairs of stones at the first falls. These mills are now owned by Thomas Kempshall. The stone part of these mills is 105 feet long and 76 feet wide, six stories high, besides the grinding floor and attic.” There was also a wooden attachment that was 50 feet by 75 feet and four stories high, with a wing projecting over the street and canal basin that was 65 feet by 40 feet, and four stories high.

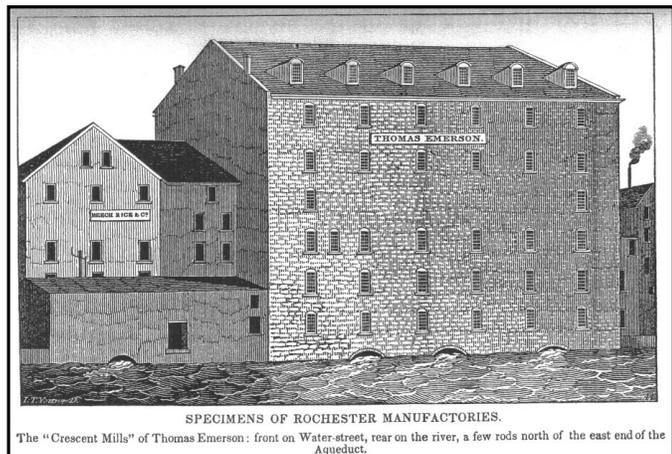
The mills of Emerson and Strong, pictured here, can be best described again by entering a quote from the *History of Monroe County*: “In 1831, Erasmus D. Smith erected at the first falls the mills, with five pairs of stones, now owned by Joseph Strong. They are between the aqueduct and the main bridge---front on Child’s Canal-basin and rear on the river. These mills are 107 feet long, of which 37 foot is wood, and 50 feet wide, four stories high, beside attic and basement grinding floor.”



SPECIMENS OF ROCHESTER MANUFACTORIES.
The “City Mills” of Joseph Strong, a few rods north of the west end of the Aqueduct, rear on the river, front on Child’s Basin.

Photo 7 Mills of Joseph Strong at Rochester

In the same vein, the Emerson Mills, are described: “In the same year (1835), Thomas Emerson and Jacob Graves erected at the first falls the mills, with six pairs of stones, now owned by Thomas Emerson. Built of stone, front somewhat crescent-shaped ---100 feet long, 50 feet wide, six stories high from the river, besides attic and basement.”



SPECIMENS OF ROCHESTER MANUFACTORIES.
The “Crescent Mills” of Thomas Emerson : front on Water-street, rear on the river, a few rods north of the east end of the Aqueduct.

Photo 8 Mills of Thomas Emerson at Rochester

Manufacture, Inspection, and Export

The shift from small local mills to larger mills for the efficient production and export of quality flour began around 1750. Community records of business activity do not permit the precise tracking of flour production and export during the mid 18th century. Recent scholarship offers some clues for the port of Alexandria, Virginia which at that time was one of five leading ports along with Boston, New York, Philadelphia, and Baltimore. British customs records and Virginia naval documents have been used to estimate the amounts of grain exported from Virginia ports for the years 1737-1742 and 1768-1772²⁶. The average number of equivalent annual barrels of flour for the period 1737-1742 was about 8000 barrels. By 1768-1772 the number had risen to about 60,000 barrels (an alternate estimate puts this figure at about 90,000 indicating the inherent uncertainty in such estimates). Pennsylvania far outstripped Virginia in the export of flour during the colonial period; for the period 1768-1772 the comparable figure for Pennsylvania was about 300,000 barrels. For New York the figure was about 80,000-100,000 barrels and for Virginia about 60,000 to 90,000 barrels.

In 1810, Pennsylvania had 2,000 mills and was the largest producer of flour, producing about 2,000,000 barrels or about one-half of the total US production²⁷. The total US production in 1810 was about 4,000,000 barrels valued at about \$21,000,000. The manufacture of flour was second only to textiles in value and represented 16 % of the total manufacturing. In this year, Virginia was second in production, producing about \$5,500,000 worth of flour, or about 1,000,000 barrels from its 441 mills. In 1850, forty years later, the total US production, from about 14,000 mills, was about 40,000,000 barrels or a 10 fold increase; of this, about 16,000,000 barrels were exported.

All export flour was required by law to be inspected for quantity and quality. Such laws for New York and Virginia were enacted in 1785. Inspections were carried out in the major commercial and export cities of New York, Philadelphia, Baltimore, Richmond, and Alexandria. The city mills were close to the inspection institutions and depended on the inspections to maintain their large export sales. The country mills were more numerous and produced a majority of the flour. The country mills also competed in the export markets with the cities. The country mills claimed to be disadvantaged by the inspection process as their product was discounted; they sought legislative relief²⁸.

Success in export flour manufacture required the production of quality flour with an adequate shelf life for the long voyages to South America, the Caribbean, and Europe. Shelf life was improved by sound barrels and low moisture content of the flour. These qualities were advanced by the legally required inspection system located in these ports. The laws laying out the inspection standards were state laws and the inspectors were located in the major ports with their large and numerous city mills. Inspection systems were in place in the major ports before 1800. Inspectors were appointed by the courts or by the executive and were independent of the mill owners. The inspectors were located in

²⁶ Duffy, Thomas F., *The Decline of the Port of Alexandria, 1800-1861*, MA Thesis, Georgetown University, 1965

²⁷ Coxe, loc cit

²⁸ Commonwealth of Virginia, *Journal of the House of Delegates*, (Richmond: Thomas Ritchie, 1831-1832, Document #31)

the major port cities. The flour from country mills was brought, in the barrel, by wagon or canal boat and presented for inspection. All inspections were of the barrel after packed. The inspector drilled a hole in the barrel, removed a sample, and, by his natural senses, examined it for texture, moisture, and odor. The quality (“superfine”, “fine”) was stamped or burned on the barrel along with the name of the manufacturer. In Richmond, Virginia, the labeling also distinguished “city” flour and country or canal flour. The market presumption was that city flour was better.

In the decade from 1820-1830, the annual inspections in Richmond totaled about 150,000 barrels, in Baltimore about 400,000 barrels, and in Alexandria about 160,000 barrels. All flour for export had to be inspected. The manufacturer paid a small fee for each inspected barrel. The inspection process served to establish standards and quality classes for the flour passing through an individual city; there were apparent significant market differences in quality from city to city. The leadership in quality as perceived by the market shifted from Philadelphia to Baltimore to New York over the first half of the 19th century. Country mills claimed to be disadvantaged by the proximity of the inspector and the city mills. On occasion the country mill owners appealed to the State legislature for a more level playing field. City mills had another, and perhaps more important, advantage over country mills in their close and intimate relationship with the customer and his broker. The result was that city mills earned a higher price for their flour.

Table 1. Exports of Flour from Baltimore in Thousands of Barrels

Data from Kuhlmann²⁹, pg 40

To:	1840-1844	1846-1850	1851-1855	1856-1860	1861-1865
Brazil	107.4	108.0	122.7	128.1	154.1
Argentina	7.1	12.5	17.8	26.0	10.9
Venezuela	12.7	10.2	8.7	4.0	.7
Great Britain	25.5	112.3	175.8	67.1	38.5
West Indies	99.1	110.3	139.9	150.6	85.6
Other	32.3	83.2	72.9	87.3	32.5
Total	284.3	436.6	537.8	463.0	322.2

The pattern of the export trade is illustrated by the above figures for Baltimore. Baltimore, during this period, was the leading exporter of flour. Production and inspections patterns for Virginia and Maryland are provided by the Table below. The standard export “barrel” held 196 pounds of flour and required 4.5-5.0 bushels of wheat to produce.

²⁹ Kuhlmann, loc cit

Table 2 US Wheat/Flour Production & Export in Barrels

Data from: *Historical Statistics of the United States*³⁰, *Historical Statistics of the States of the United States*³¹, *The Development of the Flour Milling Industry in the United States*³² and *Coxe*³³.

Year	US Production	Maryland Production	%	Virginia Production	%	Baltimore Inspections	Richmond Inspections	US Exports	% of Total Exports
1770								507,000	18.9
1792								1,014,000	
1800								3,000,000	
1810		275,110		1,000,000		437,011		3,900,000	6.0
1820						473,340	132,720	5,300,000	5.9
1830						544,017	214,980	4,700,000	7.0
1838	18,000,000					421,000			
1840		466,700				562,771	192,18	4,100,000	7.5
1842									
1848	22,000,000								
1850		918,818	4.5	2,491,169	11.2	1,012,766	353,264	12,300,000	4.8
1852									
1853						1,180,500			
1858	38,000,000								
1860	39,800,000	1,356,329	3.5	2,917,995	7.6			15,800,000	4.6
1862	42,400,000								
1870	47,900,000	1,283,229	2.0	1,644,175	2.6			11,500,000	13.4
1880	64,300,000	1,778,859	1.7	1,739,150	1.7			22,900,000	23.5

All of this led to an industry that served and was admired by the world. This recognition is most evident in the report³⁴ prepared by the Prussian government based on a two year survey by two experienced millwrights who were sent to the United States to examine the US milling industry. Their fascinating study of American mills was published in Berlin in 1832. The study was titled: *Contributions to the Study of the American Milling System and Flour Production*. The primary authors were German millwrights, F. Wulff and Carl Frederick Ganzel. Ganzel and Wulff were sent by the Prussian government to the new United States to find out about the innovations in American milling that were sweeping our east coast led by the ideas of Oliver Evans³⁵. The study by these two German experts provides new insights in how American milling was perceived at the time of Philip

³⁰ US Bureau of the Census, loc cit

³¹ Dodd, Donald, "Historical Statistics of the States of the United States"

³² Kuhlmann, loc cit

³³ Coxe, loc cit

³⁴ Beuth, Ganzel, & Wulff, *Contributions to the Study of the American Milling*, loc cit

³⁵ Hunter, Brooke, "Industrial Espionage along the Delaware", (Rider University, 2005)

Carper's ownership of the brick mill at Colvin Run. Wulff and Ganzel were students; their trip was sponsored by the Prussian Ministry for Commerce, Trade, and Architecture. They were in the United States from August 6, 1827 to June 20, 1829, and visited over 40 cities and many mills. The study was motivated by the inability of the small scale German milling infrastructure to compete in the international flour market against the larger-scale and more efficient American milling system. The Germans wanted to discover and transfer American technology to Europe, and they did. After their return, a new mill was constructed near Oranienburg, in Prussia, using American technology. In our area, Wulff and Ganzel visited mills in Baltimore, Alexandria, Fredericksburg, Richmond, Shepardstown, and Winchester.

The Movement West and the Growing of Grain

The story of America is of people coming from Europe, settling briefly, and then moving west to take advantage of the opportunity of new land. The native occupiers of the land also moved west ahead of the European immigrants. The growing and milling of wheat moved with these immigrant people. The technology of flour manufacture also advanced. The first settlements used the methods they brought with them. Manual means were replaced by horse mills, tide mills, windmills, and water-powered mills. In the Mid-Atlantic States, water power was abundant and became the energy source of choice. The land for agriculture in Virginia north through New York was ideally suited to the growing of cereal grains. Production of wheat and flour soon surpassed local needs and by 1750 an export industry began to flourish in the mid-Atlantic region. Until 1860, the Mid-Atlantic region was the leading producer of wheat reaching just over 50,000,000 bushels a year. The invention of improved tools for preparing the soil, planting the seed, and harvesting and threshing the grain increased productivity. Both English and American inventions were significant.

The manufacture of flour in early America benefited from ample sources of water power and extensive fertile regions for the growing of cereal grains. The states of Pennsylvania, New York, Virginia, and Ohio were the largest producers of wheat. In 1850 the US total production of wheat was 100,000,000 bushels³⁶. Ten years later, the production had increased by over 70%. This dramatic increase was due to the rapid expansion in the mid-west states where production grew from about 40,000,000 bushels in 1850 to over 90,000,000 bushels in 1860. During this same period, production in the eastern Mid-Atlantic States remained at about 50,000,000 bushels.

By 1860, the mid-west states, between the Ohio and Mississippi Rivers, surpassed the Mid-Atlantic, producing over 90,000,000 bushels of the total US production of 173,000,000 bushels. Of this total, over 70,000,000 bushels or about 15,000,000 barrels of flour were exported. St Louis was now the leading flour manufacturing city, surpassing Rochester, Baltimore, Philadelphia, and Richmond. Steam, steel, and railroads were rapidly replacing water power, wood, and canals. In 1860, there were almost 14,000 mills operating in America, most of these mills were west of the Allegheny Mountains and the Mid-Atlantic region. By the close of the 18th century, Minneapolis

³⁶ US Bureau of the Census, *Historical Statistics of the United States, 1789-1976* (Washington: Government Printing Office)

was the leading producer of flour which could be shipped to London within two weeks by steam powered trains and ships

Conclusions

In 1788, at the beginning of the new republic, conditions were in place for unprecedented growth in the flour manufacturing industry in the United States. Oliver Evans had published plans for automated and efficient production of quality flour. The Mid-Atlantic States possessed the natural resources of land, climate, and waterpower to support the rapid growth of this industry. Canals and passable roads were under development. But most importantly, world markets were expanding in Europe, the Caribbean, and South America.

An examination of these many sources supports the following general conclusions about the flour manufacturing and export industry over the years 1790-1860:

- During the period of 1800-1860, America financed its industrial growth through the export of commodities.
- The manufacture & export of flour was a leading and expanding commodity industry, second only to cotton.
- This industry was concentrated in a few cities of the Mid-Atlantic region and in a large number of country mills.
- The majority of flour came from country mills.
- This flour industrial technology was based on the ideas of Oliver Evans³⁷, advances in agronomy and farming tools, water power, canals, materials of wood and forged iron, and effective flour quality inspection laws.
- Labor was part slave and part free.
- From the beginning, the center of the industry was moving west.

³⁷ Bathe, Greville & Dorothy, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: Historical Society of Pennsylvania, 1938)

Appendix

Graphs of Selected Economic Indicators

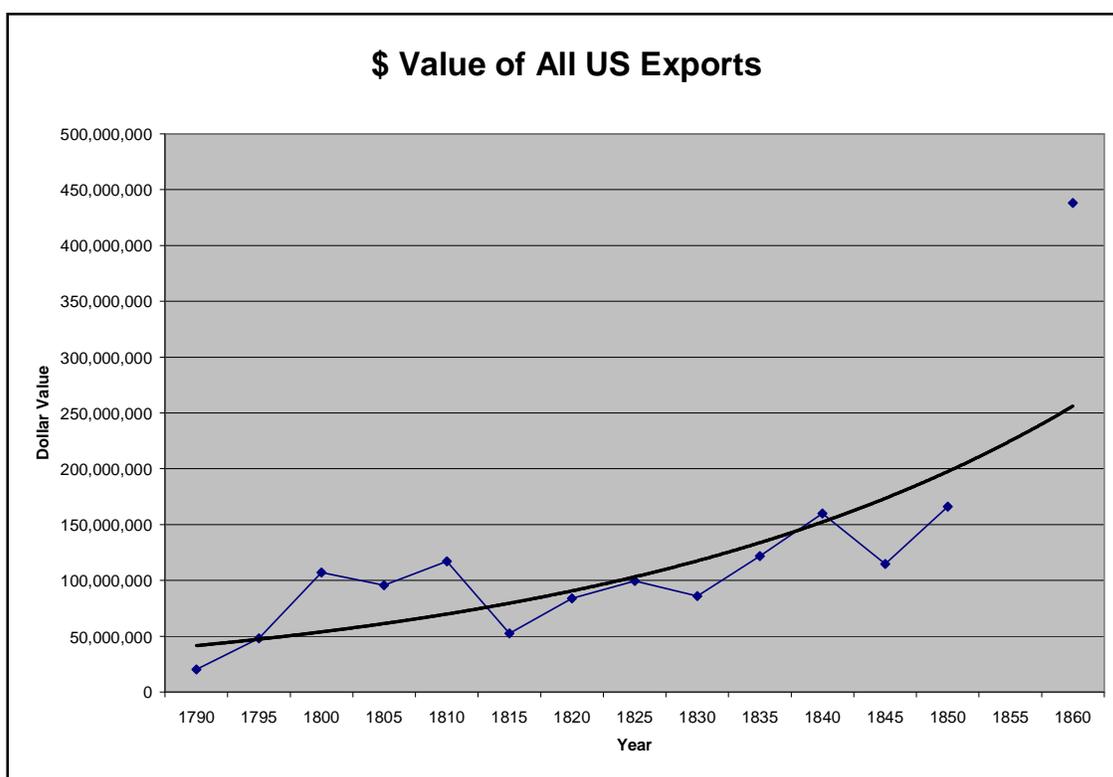
The following four graphs³⁸ of basic economic factors indicate the conditions of growth in the flour market from 1790 to 1860. This was a period when the economy of the new republic was expanding as it approached the industrial revolution. The American scene was one of population growth, expanding markets in Europe and to the south, favorable agricultural conditions, ample waterpower, an innovative people, and a growing transportation infrastructure. The export of commodities was the source of capital for this economic growth. The export of flour was a leader in the nation and was the leader in the Mid-Atlantic region.

The dollar value of all US exports during the 70 years leading up to the American Civil War grew from about \$20 million to over \$400 million while the population expanded from about 2 million persons to about 50 million.

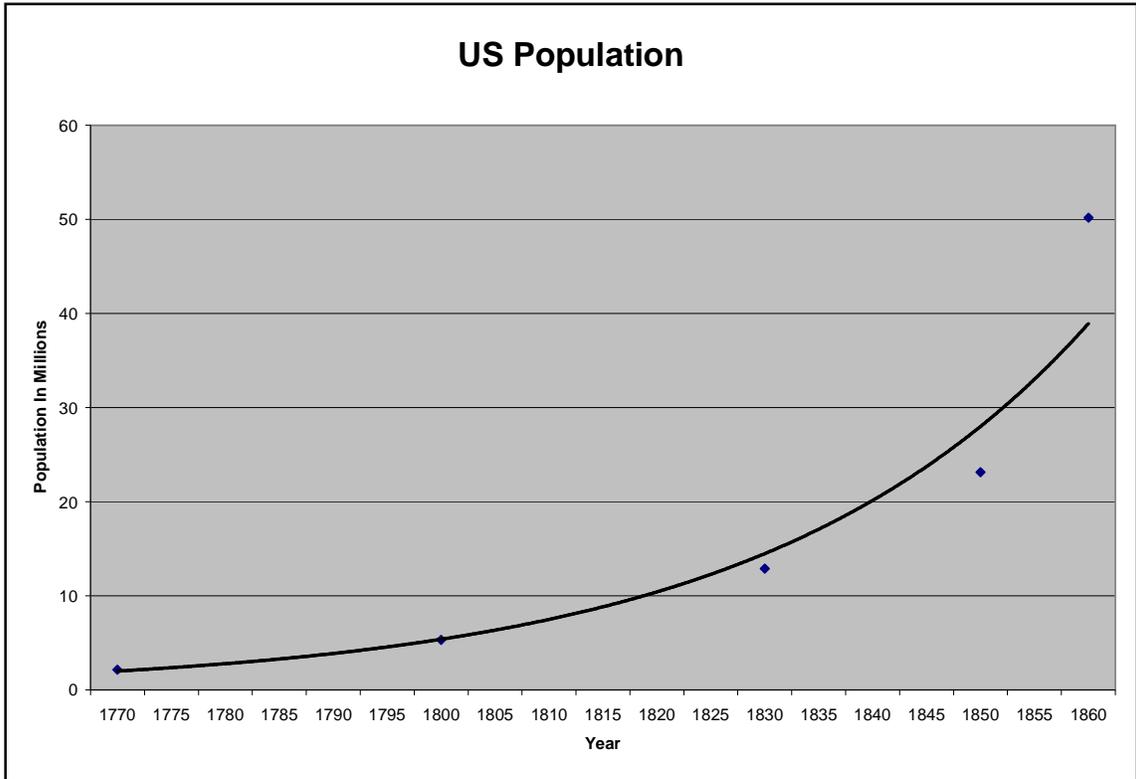
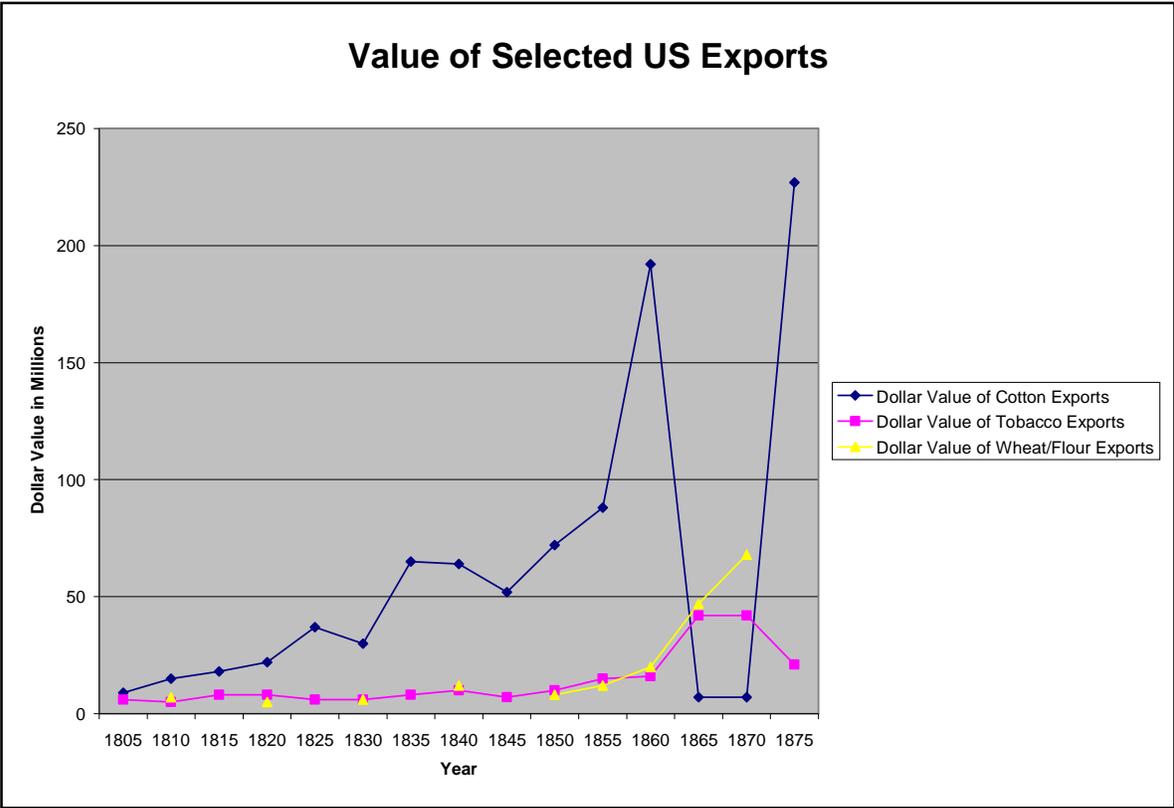
Flour exports grew from 1,000,000 barrels to over 20,000,000 barrels.

The export of the leading commodity crop of the south, cotton, reached almost \$200,000,000 during this period. Flour was a distant second, but the leading export of the Mid-Atlantic States. The value of flour exports reached about \$40,000,000 in 1860.

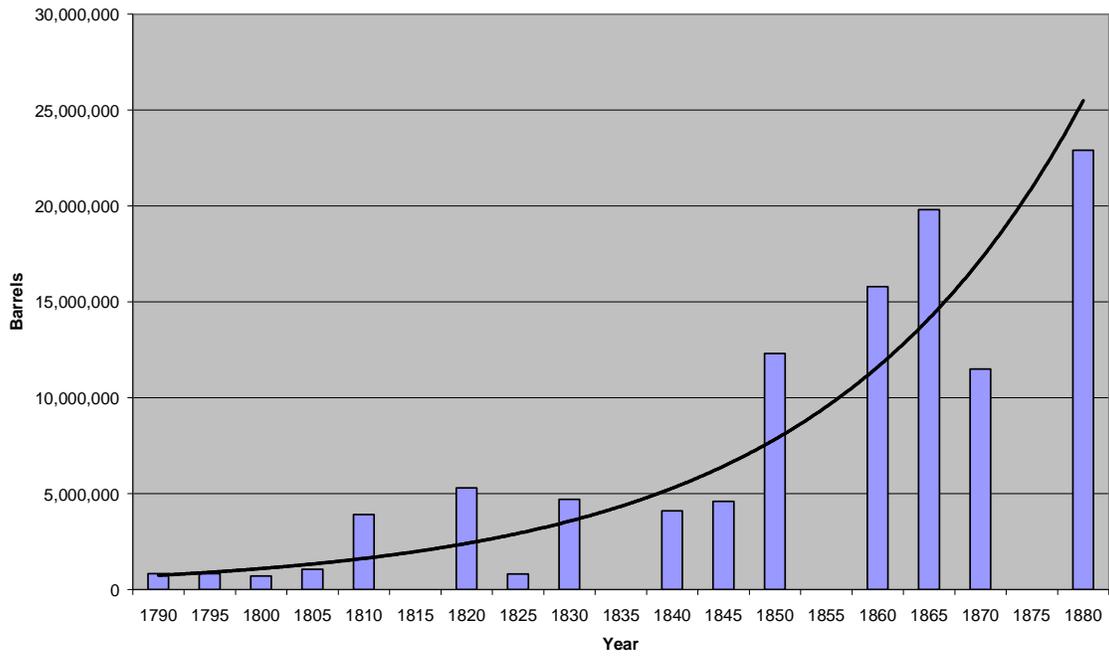
This period was truly the golden years for the manufacture and export of flour based on water power and the technology of Oliver Evans.



³⁸ US Bureau of the Census, loc cit



Annual US Flour Exports

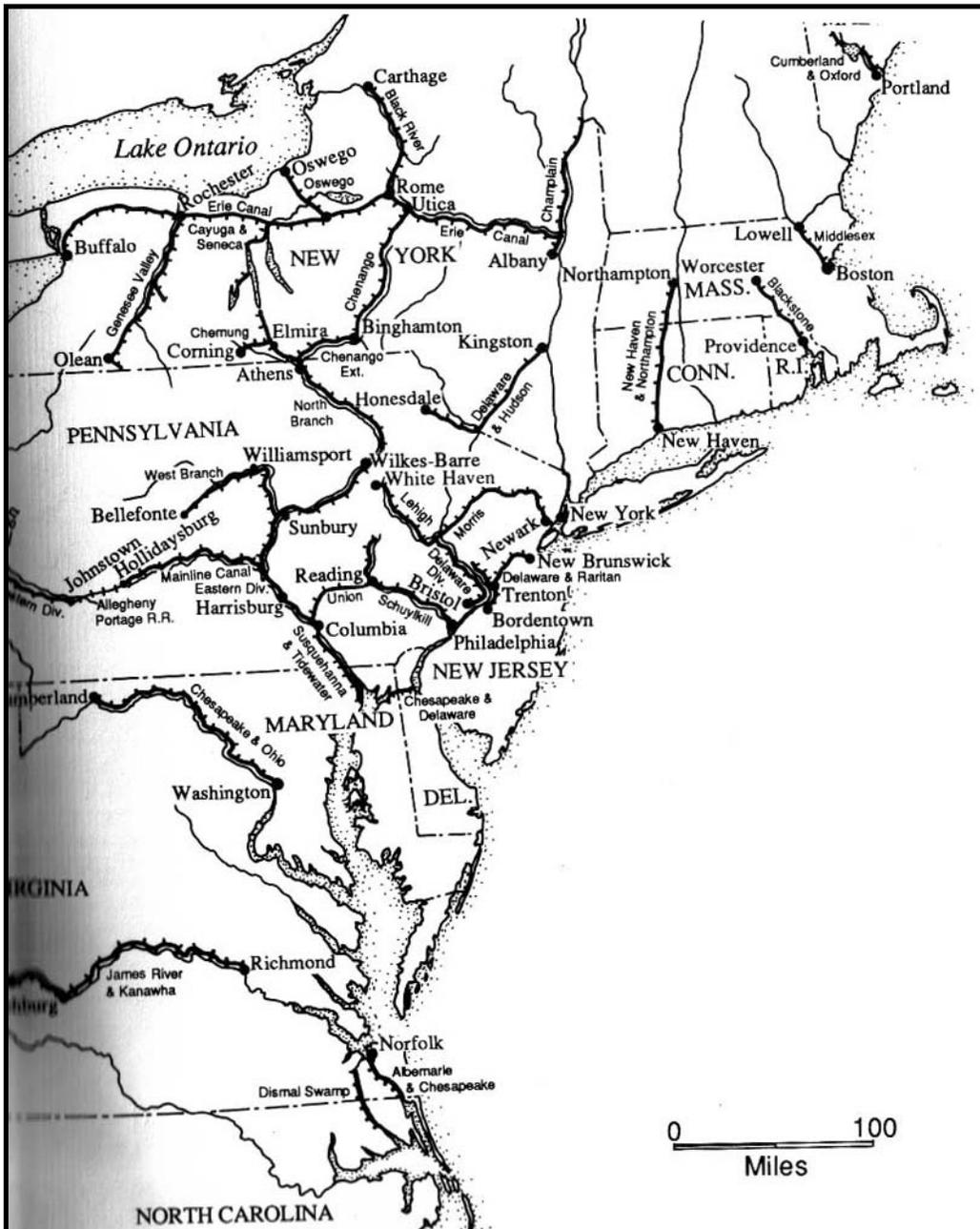


Map of Mid-Atlantic States In 1855

The map³⁹ shows the Erie Canal, the James River and Kanawha Canal, the Chesapeake and Ohio Canal, and the Susquehanna and Tidewater Canal.

The locations of the major milling center cities of Rochester and Oswego, New York; Baltimore, Maryland; and Richmond, Virginia are also shown.

Baltimore is at the mouth of the Susquehanna Canal. The port of Alexandria, Virginia is at the end of the Chesapeake and Ohio Canal. The milling city of Richmond is on the James River Canal and Rochester is on the Erie Canal.



³⁹ Shaw, Ronald E., *Canals for a Nation, the Canal Era in the United States 1790-1860*, the University Press of Kentucky

1855 Map of the City of Richmond, Virginia

- This is an 1855 government map of the city of Richmond, Virginia. A comparable map of Rochester, New York could not be located.
- The map shows the James River and Kanawha Canal, with the turning basin, on the north side of the river. The three 1855 buildings of the Gallego Mills are shown at the east end of the turning basin.
- Next to the river and south of the turning basin, a mill race is shown. This mill race was later called the Haxall Canal. The Haxall Mills were located on the river south of the mill race and west of the intersection of the race and the Canal.
- Before 1855, there were grist mills at the Tredegar Iron Works and to the west of the Iron Works on the Canal. These mills were located from 50 to 100 feet above the river.
- On the south side of the river, there is a second mill race serving mills at the end of the Mayo Bridge.

