ASME International

The American Society of Mechanical Engineers

COLVIN RUN MILL

A Historic
Mechanical Engineering Landmark

Fairfax County Park Authority
Great Falls, Virginia

May 20, 2001

Grain How and Mechanical Systems in Colvin Run Mill

The arrow line in the diagram below shows how grain travels through the automated milling mechanisms at Colvin Run Mill.

The grinding process: numbers 1 through 11

First, grain is weighed in the beam scale (1). It is then gravity-fed into a storage bin (2) in the basement. From there, a grain elevator (3) carries it up to the top floor of the mill. Then it falls into chutes (4) leading to storage bins (5) on the floor below and to the grinding stations (6) on the main floor. From the grinding stations, flour falls through chutes to another grain elevator (7) which carries it to the top floor where it is conveyed (8) to the hopper boy (9) to be raked and cooled. It then falls to the floor below and travels through the bolting chest (10) where it is sifted and finally falls back down to the main floor where a barrel packer (11) packages it for shipping.

The major mechanisms: numbers 12 through 18

1. Beam scale - weigh-in bulk grain delivered to mill
2. Bulk grain bin - storage
3. Bulk grain elevator - carries grain to top floor
4. Rolling screen and fan - removes foreign material, dirt, straw, smut, chaff from grain
5. Garner - holding raw grain for immediate use
6. Hopper - holds grain about to be ground
7. Flour/meal elevator - carries raw flour/meal to top floor
8. Conveyor - carries raw flour to hopper boy
9. Hopper boy - cools and dries flour (by stirring action of large paddle inside tub)
10. Bolting chest - separates bran or skin of wheat from flour: produces various grades of flour according to fineness
11. Flour packer: for flour shipped in barrels
12. Trundle (also known as "bird cage gear" for its appearance of an oversized bird cage)
13. Horizontal drive shaft
14. Wallower
15. Greater face wheel
16. Hoist
17. Vertical drive shaft: transmits power from basement gear assembly to equipment on top floors
18. Top of elevator

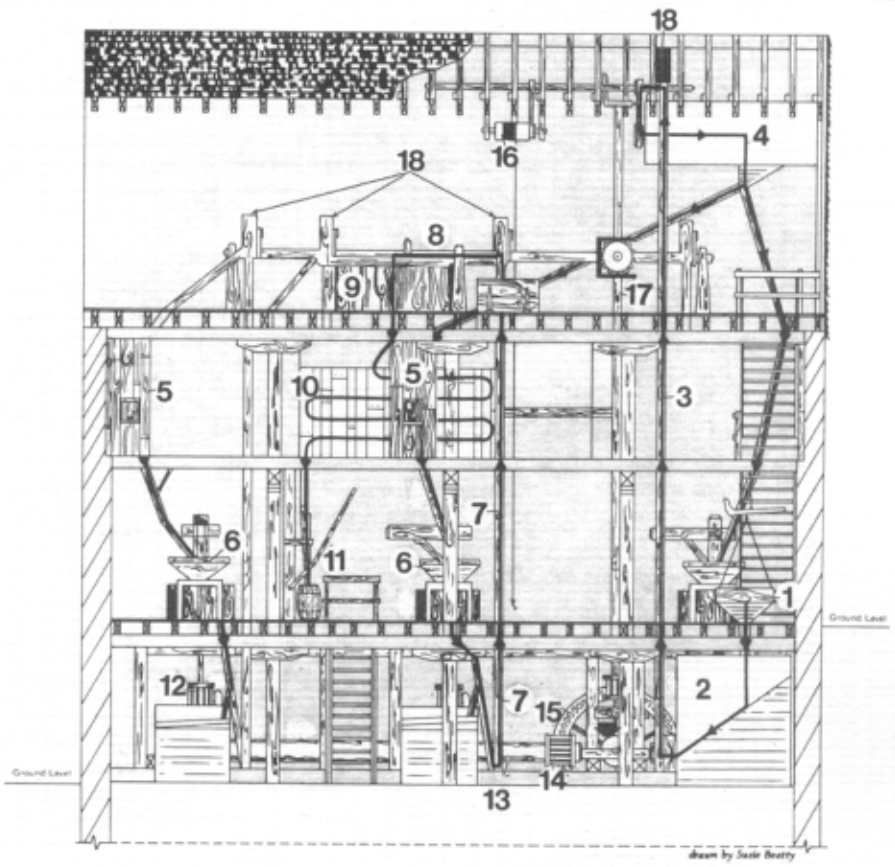
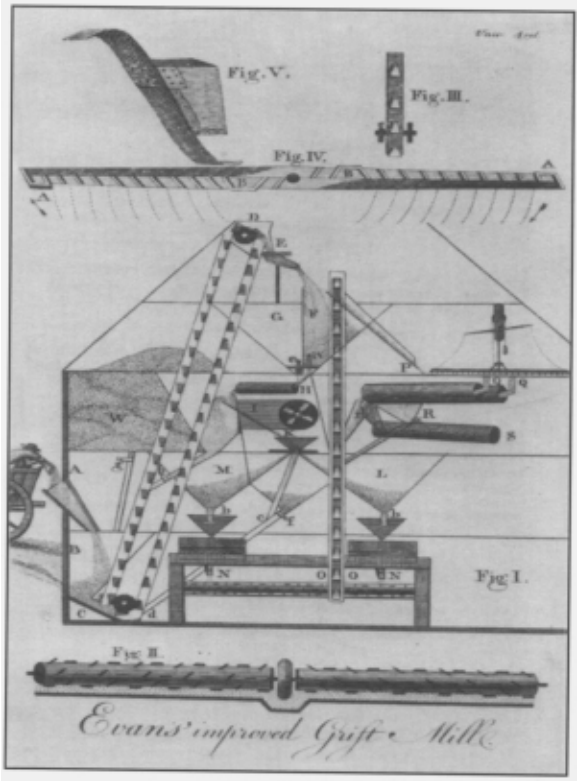


DIAGRAM OF THE MAJOR MECHANISMS OF COLVIN RUN MILL

Introduction

Built circa 1813, Colvin Run Mill is the sole surviving operational nineteenth-century water-powered mill in the Washington, DC, metro area, and its restored mechanism is a nationally significant example of automated technologies pioneered in milling and later adopted across American industry. The mill utilized revolutionary design concepts developed by the leading mechanical engineer of the day, Oliver Evans, in his 1795 book, *The Young Mill-wright and Miller's Guide*. Evans' key conceptual breakthrough, demonstrated in the Colvin Run Mill, was to link all the processes of grinding into one continuous flow operation by using gravity and mechanical devices that eliminated manual handling of grain, meal, and flour.



Automation required many mechanical motions and some entirely novel devices invented by Evans, including a mechanical hopper boy, a raking device used to cool flour. Colvin Run Mill exhibits the sole operating hopper boy known in the United States. In combination, Evans' milling innovations boosted output while curtailing labor costs. In the long run, they provided direct precedents for the mass production technologies that came to epitomize American manufacturing.

While other industries rose up by adopting similar techniques and technologies, Colvin Run Mill ran on quietly as a commercial mill for over a century, grinding grain received from local farmers for shipment to distant markets. Commercial milling ended at the site in the mid-1930s and thereafter the mill was abandoned. Citizen interest inspired the Fairfax County Park Authority to acquire the property in the mid-1960s. After a complete restoration, the mill opened as a museum in 1972 and visitors today can observe its historic machinery in full operation.

Facility History and Significance

Colvin Run Mill is a working example of Oliver Evans' (1755-1819) automated process that revolutionized late 18th and early 19th century flour milling in America. His innovative concepts were the foundation of the modern automated industries that followed. He was granted a federal patent in 1790 on milling improvements, and by 1792 more than 100 mills had adopted his machinery. Locally, George Washington received one of the first licenses to use Evans' system in his mill on Dogue Creek in Fairfax County.

Flour milling was one of the most important services performed in 18th and 19th century Virginia. In 1774 George Washington wrote, "The whole of my Force is in a manner confined to the growth of Wheat and Manufacturing of it into Flour." While some large plantations operated their own mills, most people depended on one of the many water-powered gristmills scattered on local waterways for their flour and meal. Wheat and corn production increased in northern Virginia as tobacco yields declined in the 18th century, and local farmers found a wide market for their grain and milled flour along the eastern seaboard, in the West Indies, and in Europe. Thus, merchant mills like Colvin Run Mill

began to develop in northern Virginia to serve the growing demand of local farmers and world markets.

The circa 1809 merchant mill along Colvin Run, built by William Sheppard, stands on land once owned by George Washington. Although he died before the construction of the present mill, Washington recognized the potential of the location as an ideal site for a mill and had established a *mill seat* here in the 18th century. Philip Carper purchased the mill from Sheppard in 1811 and in 1813 he paid the first documented tax on flour produced here.

The location of the gristmill was determined by its proximity to a reliable source of falling water and to the turnpike. Over time, a thriving rural village grew up around the mill as other businesses and services were established by entrepreneurs eager to serve the mill's customers. Along with the mill, a blacksmith shop, several general stores, a post office, and a schoolhouse became centers for neighborhood commerce and community activities.

A series of merchant millers operated the mill from 1813 through the mid-1930s and their prosperity waxed and waned with the agricultural economy. John Powell, who owned the mill during the Civil War and Reconstruction, was especially hard hit. He filed for bankruptcy in 1872 and the mill eventually was sold. By the 1880s, the local economy was on the upswing and the mill was about to enter its most prosperous period.

From 1883 to 1934, the Millard family owned and operated the merchant mill along Colvin Run. First Addison, then his widow Emma, and finally their sons Sam and Alfred modernized and rebuilt the mill pond, the mill race, and the machinery. By 1930 it was estimated that over one million bushels of grain had passed through Colvin Run Mill. In the mid-1930s Alfred died, Sam retired, and their milling business ceased. Shortly thereafter the state highway department began construction of a new road that went through the mill race, cutting the mill off from its power source. The mill was abandoned to sit idle for many years until local community support sparked its acquisition by the Fairfax

County Park Authority. The Park Authority then began an extensive restoration that included reconstructing the waterwheel and tunneling beneath the modem road to reestablish the mill race.

Technical Background and Description

Oliver Evans' automated milling system integrates several elements into a continuous process that greatly reduces the amount of manual labor required to operate a gristmill. He introduced his improvements in the machinery for grinding grain into meal and flour in Chapter IX of his miller's guide:

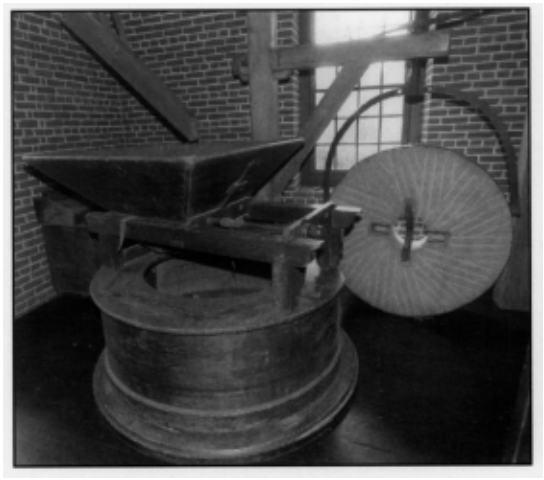
> These...machines are...applied...so as to perform every necessary movement of the grain, and meal, from one part of the mill to another, or from one machine to another, through all the various operations from the time the grain is emptied from the wagoner's bag, or from the measure on board the ship, until it be completely manufactured into flour...and separated, ready for packing into barrels, for sale or exportation. All which is performed by the force of the water, without the aid of manual labour, excepting to set the different machines in motion, &c. This lessens the labour and expense of attendance of flour mills, fully one-half.
>
> -- *Oliver Evans, 1795*

In Colvin Run Mill four machines automatically move grain and meal from one part of the mill to another through a continuous grinding and sifting process.

- Grain elevators – buckets attached to endless canvas or leather straps which revolve over two pulleys – carry grain to upper levels at a rate of three hundred bushels an hour.
- Wooden Archimedean screws (or conveyors) – which prior to Evans had been used only to lift water – push grain and meal horizontally through chutes and machinery.
- An automated shaker assembly sifts and separates ground grain into different grades.
- A mechanical rake – called the hopper boy – stirs and spreads meal to cool and dry.

The mill machinery is powered by a twenty-foot diameter overshot waterwheel made of white oak. Inside the mill, gears with teeth of rock maple transfer the waterpower to the grinding stones. A dense and durable wood, rock maple was difficult to work, but those qualities also made it an ideal choice for gear teeth under heavy loads. Throughout their work, millwrights achieved considerable accuracy in shaping wooden parts, but their mechanisms often included wedges that allowed a miller to adjust for the effects of aging, drying, or swelling of the material. The wooden waterwheel and gearing reflect Colvin Run Mill's origin in the early nineteenth century, as millwrights increasingly substituted iron for these parts after 1850.

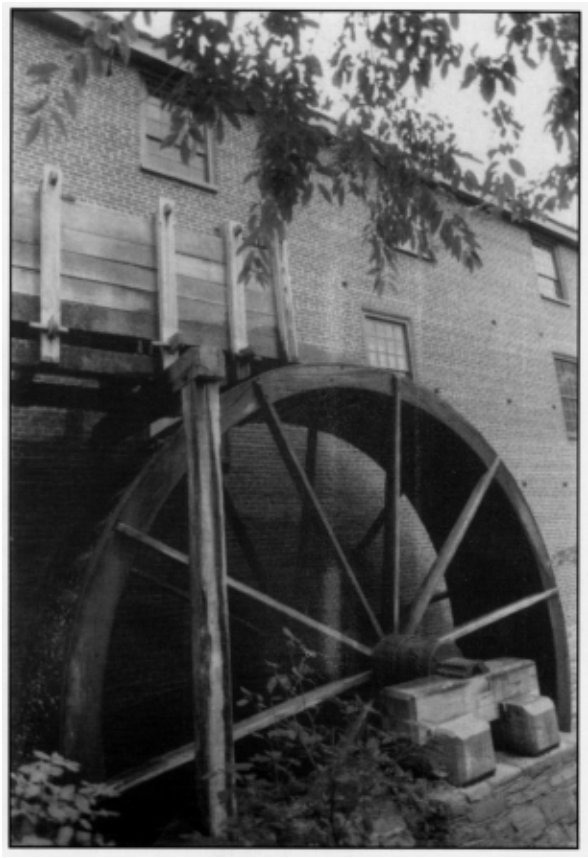
The most imposing fixtures on the first floor of the mill are the three grinding stations located along the west side of the building directly above the cog pit. Two stations are equipped with pairs of millstones that are similar in their basic features. In each, the



bedstone, which remains stationary during grinding, is fixed in the floor and rests on a special set of beams called stone bearers. An iron drive shaft that holds and turns the upper, or runner, stone comes up through a hole in the center of the bedstone. The runner stone may be raised or lowered as needed to regulate the fineness of the grind.

Waterwheel

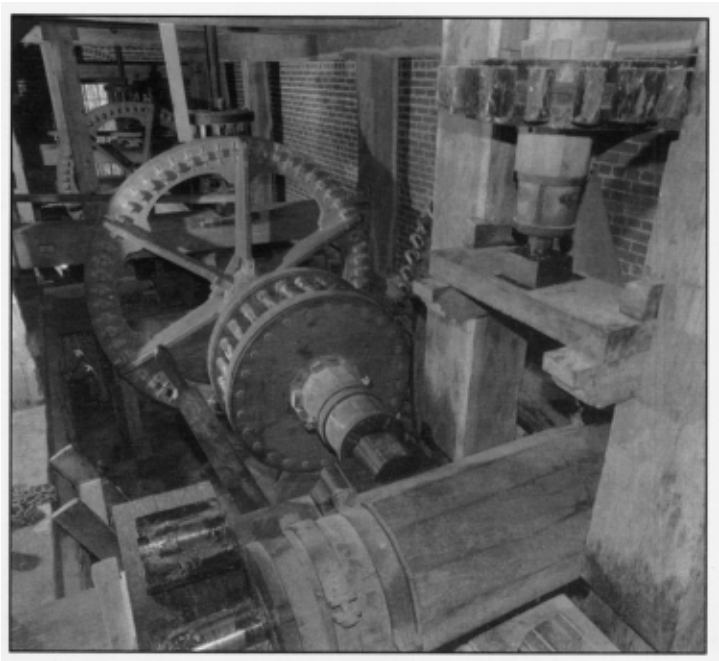
Colvin Run Mill is powered by a twenty-foot diameter overshot wheel made of white oak. Ten arms extend out from a two-foot diameter wooden shaft. The shaft passes through the brick wall of the mill from one bearing block fitted into the outer wall of the tailrace to another block inside the basement of the mill.



Around the outside of the wheel are sixty buckets inclined at an angle to catch water falling from the flume above. Each bucket holds approximately fifteen gallons (or 125 pounds) of water. The weight of water filling the buckets turns the waterwheel in a clockwise direction (when seen from outside the mill) and produces up to twenty-six horsepower. The waterwheel turning outside at a rate of 10 rpm spins the top grinding stones inside at 100 rpm.

Cog Pit and Gears

The cog pit extends the length of the mill along the west wall. It is nine feet wide and is excavated four feet below the level of the basement floor. The entire gearing that transmits power throughout the mill is contained within a husk frame – a heavy open framework of white-oak posts and beams that is set upon the building foundation but not tied into the walls of the mill. The husk frame and the machinery enclosed within it are said to be "floating" rather than fixed within the mill.



The gears transmit power from the waterwheel to all the machinery in the mill, including three shaker boxes in the basement, the three grinding stations on the first floor, the bolting chest and hopper boy on the upper floors, and the grain elevators that operate throughout the four floors of the mill.

Fitted onto the interior part of the waterwheel shaft and taking its power directly from the waterwheel, is the ten-foot diameter greater face gear. A series

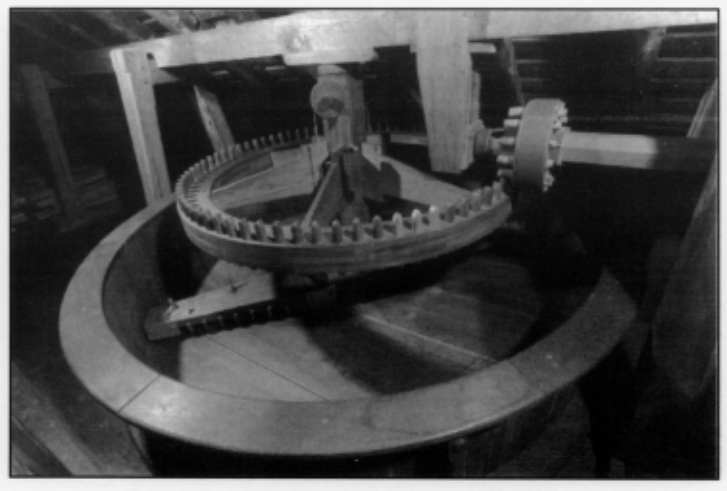
of wooden teeth, made of rock maple, are set into the rim of the greater face gear to engage wooden teeth on the eight-inch diameter vertical power shaft. The vertical shaft extends up to the top floor of the mill and transmits power from the water-wheel to the machinery on the upper floors and to the grain elevators.

To transmit power to the grinding stones on the floor above, the greater face gear engages a series of other gears. Two of these gears, called wallowers, take their power directly from the greater face gear. The wallowers have "teeth" formed of twelve-inch wooden pins sheathed in metal and set between two solid wooden three-foot eight-inch diameter disks.

Each wallower is attached to a sixteen-inch diameter horizontal wooden drive shaft set at right angles to the waterwheel axle. On each end of the smaller shafts, opposite the wallower, is another wooden toothed gear called the lesser face. The lesser face gears are seven feet eight inches in diameter.

Hopper Boy

The hopper boy is a mechanical raking machine invented by Oliver Evans to cool and dry flour as it came from the millstones prior to being sifted. Grain elevators carry the warm, moist flour from the shaker box in the basement up to the top floor of the mill where it is deposited in the hopper boy.



Colvin Run Mill's hopper boy is a circular wooden tub, eight feet in diameter, with low side walls and an open top. A long counter-balanced arm mounted on a center post extends across the enclosure and rotates when power from the waterwheel is transmitted to it by the vertical shaft. Flights, inclined wooden paddles on the underside of the arm, stir and spread the flour evenly until cooled. As the flour is raked, the flights push it to the center of the hopper boy where it falls through a hole into a chute leading to the bolting sifter on the floor below.

Facility Contribution

Colvin Run Mill is an outstanding example of the beginnings of early America's technological innovations. Restoration work conducted by the FCPA from the mid-1960s to 1972 returned the mill to operational condition and restored its earliest appearance. Today the mill grinds again, providing flour and corn meal not for the ports of the world or for neighboring households, but for visitors from both. Standing as a reminder of the beginnings of America's technological might, it is a masterpiece of timeless craft skill and a landmark design that help launch the industrial era.

Open to the public since 1972, the mill is the centerpiece of a historic site that also includes a nineteenth century miller's house, a circa 1900 general store, and an interpretive barn with adjacent working blacksmith shop. The historical facilities are used for interpretive exhibits, demonstrations, and special programs that provide educational and recreational experiences for visitors of all ages.

Text of the Colvin Run Mill Plaque

HISTORIC MECHANICAL
ENGINEERING LANDMARK

COLVIN RUN MILL
c. 1809

THE AUTOMATED PRODUCTION SYSTEM OF THIS MILL IS AN OUTSTANDING EXAMPLE OF AMERICA'S TECHNOLOGICAL INNOVATIONS EARLY IN THE 19TH CENTURY. ITS OPERATION IS BASED ON A MILLING PROCESS ORIGINATED BY OLIVER EVANS. POWERED SOLELY BY A WATERWHEEL, A COMBINATION OF MACHINERY AUTOMATICALLY MOVES GRAIN FROM ONE PART OF THE MILL TO ANOTHER THROUGH A SEQUENCE OF CONTINUOUS GRINDING AND SIFTING STEPS TO PRODUCE FLOUR AND MEAL

THIS INTEGRATED MACHINERY GREATLY REDUCED THE MANUAL LABOR ORDINARILY REQUIRED TO OPERATE A GRISTMILL. THE INNOVATIVE CONCEPTS DEMONSTRATED HERE WERE THE FOUNDATION OF MODERN AUTOMATED INDUSTRIES.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

2001

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The ASME Washington DC Section gratefully acknowledges the assistance of the Fairfax County Park Authority for the use of their photographs.

The History and Heritage Program of the ASME

The History and Heritage Landmarks Program of ASME (the American Society of Mechanical Engineers) began in 1971. To implement and achieve its goals, ASME formed a History and Heritage Committee initially composed of mechanical engineers, historians of technology and the curator (now emeritus) of mechanical engineering at the Smithsonian Institution, Washington, D.C. The History and Heritage Committee provides a public service by examining, noting, recording and acknowledging mechanical engineering achievements of particular significance. This Committee is part of ASME's Council on Public Affairs and Board on Public Information. For further information, please contact Public Information at ASME International, Three Park Avenue, New York, NY 10016-5990, 1-212-591-7740.

Designation

Since the History and Heritage Program began in 1971, 213 landmarks have been designated as Historic Mechanical Engineering Landmarks, Heritage Collections or Heritage Sites. Each represents a progressive step in the evolution of mechanical engineering and its significance to society in general. Site designations note an event or development of clear historic importance to mechanical engineers. Collections mark the contributions of a number of objects with special significance to the historical development of mechanical engineering.

The Landmarks Program illuminates our technological heritage and encourages the preservation of the physical remains of historically important works. It provides an annotated roster for engineers, students, educators, historians, and travelers. It helps establish persistent reminders of where we have been and where we are going along the divergent paths of discovery.

The 125,000-member ASME International is a worldwide engineering society focused on technical, educational, and research issues. ASME conducts one of the world's largest publishing operations, holds some 30 technical conferences and 200 professional development courses each year, and sets many industrial and manufacturing standards.

The Nominator and Authors

This brochure was compiled from sources found in the Colvin Run Mill Historic Site library and it was edited by Ann Korzeniewski and Ronald D. Rolfe.

Mr. Rolfe is an analyst in the Missile Technology Division, Bureau of Export Administration, U.S. Department of Commerce in Washington, D.C. He is an ASME member and past Chairman of the Washington D.C. Section. An avid fan of history and technology, this Landmark dedication effort has been a perfect merging of these two interests.

Ms. Korzeniewski has worked at Colvin Run Mill Historic Site for ten years and has been assistant site administrator since 1997. She supervises the site's volunteer program, historic artifact collections care, museum education and public programs, museum sales, and visitor services.