

# Gristmill

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A **gristmill** (also: **grist mill**, **corn mill** or **flour mill**) grinds grain into flour. The term can refer to both the grinding mechanism and the building that holds it.

## Contents

- 1 History
  - 1.1 Early history
  - 1.2 Classical British and American mills
- 2 Modern mills
- 3 See also
- 4 References
- 5 Further reading
- 6 Gallery
- 7 External links



Allied Mills flour mill on the banks of the Manchester Ship Canal

## History

### Early history

The Greek geographer Strabo reports in his *Geography* a water-powered grain-mill to have existed near the palace of king Mithradates VI Eupator at Cabira, Asia Minor, before 71 BC.<sup>[1]</sup>

The early mills had horizontal paddle wheels, an arrangement which later became known as the "Norse wheel", as many were found in Scandinavia.<sup>[2]</sup> The paddle wheel was attached to a shaft which was, in turn, attached to the centre of the millstone called the "runner stone". The turning force produced by the water on the paddles was transferred directly to the runner stone, causing it to grind against a stationary "bed", a stone of a similar size and shape.<sup>[2]</sup> This simple arrangement required no gears, but had the disadvantage that the speed of rotation of the stone was dependent on the volume and flow of water available and was, therefore, only suitable for use in mountainous regions with fast-flowing streams.<sup>[2]</sup> This dependence on the volume and speed of flow of the water also meant that the speed of rotation of the stone was highly variable and the optimum grinding speed could not always be maintained.<sup>[2]</sup>

Vertical wheels were in use in the Roman Empire by the end of the first century

BC, and these were described by Vitruvius.<sup>[3]</sup> The peak of Roman technology is probably the Barbegal aqueduct and mill where water with a 19-metre fall drove sixteen water wheels, giving a grinding capacity estimated at 2.4 to 3.2 tonnes per hour. Water mills seem to have remained in use during the post-Roman period, and by 1000 AD, mills in Europe were rarely more than a few miles apart.



Senenu Grinding Grain, ca. 1352-1336 B.C., The royal scribe Senenu appears here bent over a large grinding stone. This unusual sculpture seems to be an elaborate version of a shabti, a funerary figurine placed in the tomb to work in place of the deceased in the hereafter. Brooklyn Museum



The old water mill at Decew Falls, Niagara Escarpment, St. Catharines, Canada

In England, the Domesday survey of 1086 gives a precise count of England's water-powered flour mills: There were 5,624, or about one for every 300 inhabitants, and this was probably typical throughout western and southern Europe. From this time onward, water wheels began to be used for purposes other than grist milling. In England, the number of mills in operation followed population growth, and peaked around 17,000 by 1300.<sup>[4]</sup>

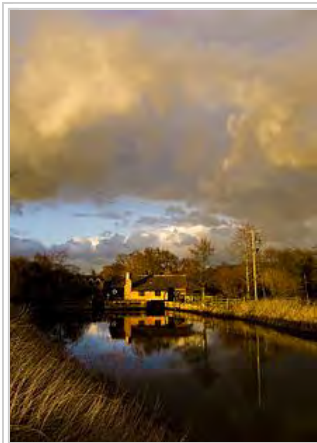
Limited extant examples of gristmills can be found in Europe from the High Middle Ages. An extant well-preserved waterwheel and gristmill on the Ebro River in Spain is associated with the Real Monasterio de Nuestra Senora de Rueda, built by the Cistercian monks in 1202. The Cistercians were known for their use of this technology in Western Europe in the period 1100 to 1350.



Grinding mechanism in an old Swedish flour mill

Geared gristmills were also built in the medieval Near East and North Africa, which were used for grinding grain and other seeds to produce meals.<sup>[5]</sup> Gristmills in the Islamic world were powered by both water and wind. The first wind-powered gristmills were built in the 9th and 10th centuries in what are now Afghanistan, Pakistan and Iran.<sup>[6]</sup>

## Classical British and American mills



Stretton Watermill, 17th-century built operational mill in Cheshire, England

Although the terms "gristmill" or "corn mill" can refer to any mill that grinds grain, the terms were used historically for a local mill where farmers brought their own grain and received back ground meal or flour, minus a percentage called the "miller's toll."<sup>[7]</sup> Early mills were almost always built and supported by farming communities and the miller received the "miller's toll" in lieu of wages. Most towns and villages had their own mill so that local farmers could easily transport their grain there to be milled. These communities were dependent on their local mill as bread was a staple part of the diet.



Wayside Inn Grist Mill in Massachusetts

Classical mill designs are usually water powered, though some are powered by the wind or by livestock. In a watermill a sluice gate is opened to allow water to flow onto, or under, a water wheel to make it turn. In most watermills the water wheel was mounted vertically, i.e., edge-on, in the water, but in some cases horizontally (the tub wheel and so-called Norse wheel). Later designs incorporated horizontal steel or cast iron turbines and these were sometimes refitted into the old wheel mills.

In most wheel-driven mills, a large gear-wheel called the *pit wheel* is mounted on the same axle as the water wheel and this drives a smaller gear-wheel, the *wallower*, on a main driveshaft running vertically from the bottom to the top of the building. This system of gearing ensures that the main shaft turns faster than the water wheel, which typically rotates at around 10 rpm.

The millstones themselves turn at around 120 rpm. They are laid one on top of the other. The bottom stone, called the *bed*, is fixed to the floor, while the top stone, the *runner*, is mounted on a separate spindle, driven by the main shaft. A wheel called the *stone nut* connects the runner's spindle to the main shaft, and this can be moved out of the way to disconnect the stone and stop it turning, leaving the main shaft turning to drive other machinery. This might include driving a mechanical sieve to refine the flour, or turning a wooden drum to wind up a chain used to hoist sacks of grain to the top of the mill house. The distance between the stones can be varied to produce the grade of flour required; moving the stones closer together produces finer flour.

The grain is lifted in sacks onto the *sack floor* at the top of the mill on the hoist. The sacks are then emptied into bins, where the grain falls down through a hopper to the millstones on the *stone floor* below. The flow of grain is regulated by shaking it in a gently sloping trough (the *slider*) from which it falls into a hole in the center of the runner stone. The milled grain (flour) is collected as it emerges through the grooves in the runner stone from the outer rim of the stones and is fed down a chute to be collected in sacks on the ground or *meal floor*. A similar process is used for grains such as wheat to make flour, and for maize to make corn meal.

In order to prevent the vibrations of the mill machinery from shaking the building apart, a gristmill will often have at least two separate foundations.

American inventor Oliver Evans revolutionized this labor-intensive process at the end of the eighteenth century when he patented and promoted a fully automated mill design.

## Modern mills

Modern mills typically use electricity or fossil fuels to spin heavy steel, or cast iron, serrated and flat rollers to separate the bran and germ from the endosperm. The endosperm is ground to create white flour, which may be recombined with the bran and germ to create whole grain or graham flour. The different milling techniques produce visibly different results, but can be made to produce nutritionally and functionally equivalent output. Stone-ground flour is, however, preferred by many bakers and natural food advocates because of its texture, nutty flavour, and the belief that it is nutritionally superior and has a better baking quality than steel-roller-milled flour.<sup>[8]</sup> It is claimed that, as the stones grind relatively slowly, the wheat germ is not exposed to the sort of excessive temperatures that could cause the fat from the germ portion to oxidize and become rancid, which would destroy some of the vitamin content.<sup>[8]</sup> Stone-milled flour has been found to be relatively high in thiamin, compared to roller-milled flour, especially when milled from hard wheat.<sup>[8]</sup>

Gristmills only grind "clean" grains from which stalks and chaff have previously been removed, but historically some mills also housed equipment for threshing, sorting, and cleaning prior to grinding.

Modern mills are usually "merchant mills" that are either privately owned and accept money or trade for milling grains or are owned by corporations that buy unmilled grain and then own the flour produced.

## See also

- List of watermills



Modern mills are highly automated. Interior in Tartu Mill, that is the biggest grain milling company in the Baltic states.

- Grist
- Hammermill
- Textile mill
- Tide mill
- Unifine Mill
- Water wheel
- Windmill
- Ship mill



The Pilgrim's Pride feed mill in Pittsburg, Texas, in August 2015

## People

- Robert L. Burns, began Consolidated Flour Mills of Kansas

## References

1. Wikander 1985, p. 160; Wikander 2000, p. 396
  2. Denny, Mark (4 May 2007). "Waterwheels and Windmills". *Ingenium: five machines that changed the world*. The Johns Hopkins University Press. pp. 36–38. ISBN 0-8018-8586-8. Retrieved 15 December 2009.
  3. Oleson, John Peter (30 Jun 1984). *Greek and Roman mechanical water-lifting devices: the history of a technology*. Springer. p. 373. ISBN 90-277-1693-5. Retrieved 15 December 2009.
  4. Gimpel, J., *The Medieval Machine*, Gollanz, 1976, Chapter 1.
  5. Donald Routledge Hill (1996), "Engineering", p. 781, in (Rashed & Morelon 1996, pp. 751–95)
  6. Adam Lucas (2006), *Wind, Water, Work: Ancient and Medieval Milling Technology*, p. 65, Brill Publishers, ISBN 90-04-14649-0
  7. "ARTFL Project: Webster Dictionary, 1913". The University of Chicago - Department of Romance Languages and Literature. Retrieved 2006-09-28.
  8. Campbell, Judy; Mechtild Hauser; Stuart Hill (1991). "NUTRITIONAL CHARACTERISTICS of ORGANIC, FRESHLY STONE-GROUND, SOURDOUGH & - CONVENTIONAL BREADS". *Ecological Agriculture Projects Publications*. Ecological Agriculture Projects. Retrieved 15 December 2009.
- Wikander, Örjan (1985). "Archaeological Evidence for Early Water-Mills. An Interim Report". *History of Technology*. **10**. pp. 151–79
  - Wikander, Örjan (2000). "The Water-Mill". In Wikander, Örjan. *Handbook of Ancient Water Technology. Technology and Change in History*. **2**. Leiden: Brill. pp. 371–400. ISBN 90-04-11123-9

## Further reading

- Richard Bennett & John Elton. *History of corn milling* (London, Simpkin, Marshall and company, 1898).
  - Volume 1 - Handstone, Slave and Cattle Mills (<https://archive.org/details/historyofcornmil01bennuoft>)
  - Volume 2 - Water and Wind Mills (<https://archive.org/details/historyofcornmil02bennuoft>)
  - Volume 3 - Feudal Laws and customs of Mills
  - Volume 4 - Some famous feudal mills (<https://archive.org/details/historyofcornmil04bennuoft>)
  - History of Cannon River Mills in Southern MN, USA (<http://www.cannonvalleymills.com>)

## Gallery



Gristmill with water wheel, Skyline Drive, Virginia, 1938



Gristmill hopper, Skyline Drive, VA, 1938. Grain was funneled through the hopper to a grinding stone below



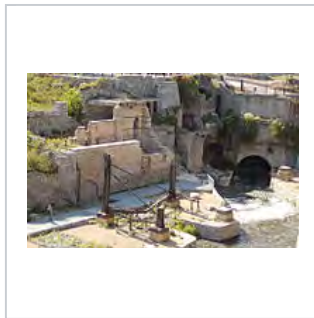
Corn over the grinding stone in Kenyon's johnnycake flour mill in Usquepaugh, RI, (near Kingston) 1940



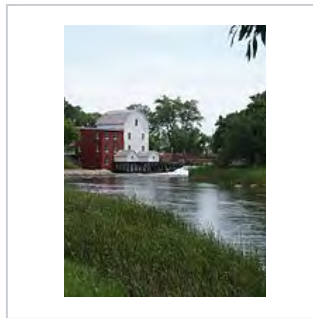
Gristmill drive machinery, Thomas Mill, Chester County, PA



Pedal powered wheat mill, Shediac Cape, New Brunswick



Remnants of some of the scores of flour mills built in Minneapolis between 1850 and 1900. Note the underground Mill race that powered mills on the west side of the Mississippi River at St. Anthony Falls



Phelps Mill in Otter Tail County, Minnesota



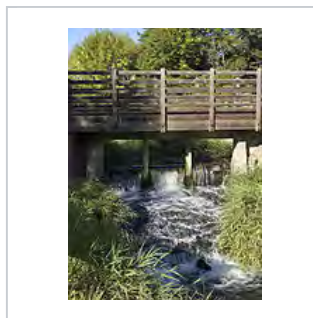
Wheel of the 1840s-era Grist Mill at Old Sturbridge Village in Sturbridge, MA



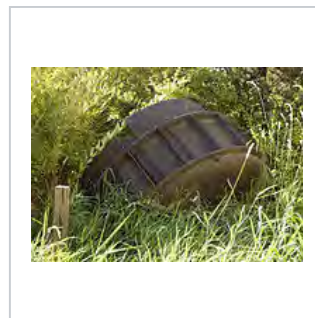
"Slipper" feeding corn into the grindstones of George Washington's Grist Mill



Splash mill from Småland, Sweden



Weir at the old grist mill in Thorp, Washington



Old turbine wheel at the old grist mill in Thorp, Washington



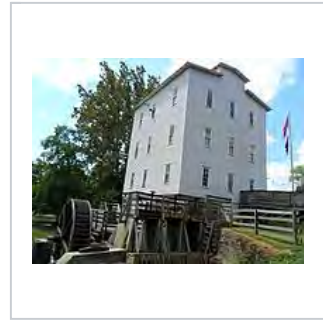
The grist mill at the Wayside Inn in Sudbury, Massachusetts



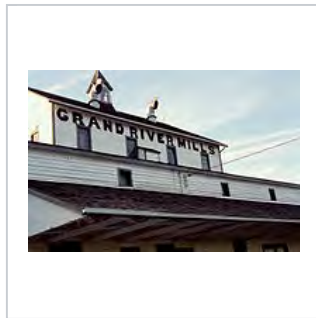
Stockdale Mill on the Eel River near Roann, Indiana



Grain mill with bevel gears outside local museum at Dordrecht



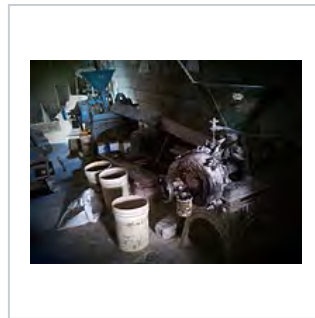
Mansfield Roller Mill in Mansfield, Indiana, USA



Caledonia Mill, Caledonia, Ontario, Canada



Close-up of a Dutch cornmill



A Flour Mill seen in India

## External links

- Southeastern Minnesota Cannon River Valley Historic Mill Information, Drawings and Images (<http://www.cannonvalleymills.com/>)
- Historic Mill Information and Images (<http://www.millpictures.com/>)
- Whitemill, Wimborne, Dorset, England (<http://www.whitemill.org/index.html>)
- The Society for Preservation of Old Mills (<http://www.spoom.org/>)
- Old Stone Mill National Historic Site of Canada (<http://www.deltamill.org/>)
- Stockdale Mill (<http://www.stockdalemill.org/>)
- Greenbank Mill (<http://www.greenbankmill.org/>)
- Gristmill diagram and description ([http://www.osv.org/explore\\_learn/waterpower/grist.html](http://www.osv.org/explore_learn/waterpower/grist.html))
- North American Millers' Association — How Wheat Flour is Milled ([https://web.archive.org/web/20100109235204/http://www.namamillers.org/ci\\_products\\_wheat\\_mill.html](https://web.archive.org/web/20100109235204/http://www.namamillers.org/ci_products_wheat_mill.html))
- Worlds Grits Festival St. George, SC (<http://www.worldgritsfestival.com/>)
- Site of first grist mill in North America, 1607 (<http://ns1763.ca/annapco/lequille.html>)
- Prewetts Mill (<http://www.hiddenhorsham.co.uk/23/prewettsmill.htm>) – a British mill built in 1861 driven by steam until the 1970s
- Working Mill in Pickwick, Minnesota, 1854 (<http://www.pickwickmill.org/>)
- Cooper Mill - Working Grist Mill in Chester, New Jersey 1826 (<http://www.morrisparks.net/aspparks/coopermillmain.asp>)
- Newlin Grist Mill (<http://www.newlingristmill.org/>)
- The Mill at Anselma - A National Historic Landmark (<http://www.anselmamill.org/>)

- War Eagle Mill - A Working Water Powered Grist Mill in Rogers, Arkansas (<http://www.wareaglemill.com/>)
- Peirce Mill and Barn, Rock Creek Park, U.S. National Park Service (<http://www.nps.gov/pimi/index.htm>)
- Graue Mill and Museum, Oakbrook, Illinois (<http://www.grauemill.org/>)

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Categories: [Flour mills](#) | [Grinding mills](#) | [Agricultural buildings](#) | [Renewable energy](#)

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