The Grist Milling Process

excerpted from “The Grist Mill-fulling Mill Complex”

from the Collections at Historic Bethlehem [PA]

The milling of flour grew to be Pennsylvania's most important export industry. After the American Revolution, Philadelphia continued to be the center of the milling trade in America. The first grist mill in Pennsylvania was "completed and made ready for community service" in 1643 in Philadelphia, 100 years before the Bethlehem mill became operational. The mill was described as "a fine grist mill which grinds both coarse and fine flour, and trade is so great that it must keep going early and late." Bethlehem's mill ground grain not only for the early community but also for the surrounding area so it is easy to see why this establishment was a necessary and popular industry in the area. There is no evidence to date, however, that Bethlehem's flour was entered into Pennsylvania's export trade.

The honesty of the Moravian millers may also have played a role in the mill's use, as well. Unfortunately, throughout history millers, had a reputation for dishonesty. Their payment was a prescribed portion, or toll, of the finished product--one-eighth part of wheat and one-sixth part of corn, for example. Unscrupulous millers would be fined if they took more, and some tricky millers had a small extra chute from the vat to a concealed bin as a means to acquire more flour than was their due. Even an honest miller might put a square housing over his round stones and take what profit accumulated in its comers. There is no mention in the records of such dealings occurring with the millers in early Bethlehem, however.

The heart of a grist mill was its grinding stones. Grinding stones were used in pairs. The bottom stone, or bed stone, was fixed into position, while the upper stone, or runner stone, moved. The stones were connected to the power source (water or wind) by a wooden "counterwheel," or contrate wheel, wedged on the horizontal drive shaft, which ran the trundle head, a small wooden lantern gear. The trundle-head shaft, usually called the spindle, turned six or eight times as fast as the waterwheel shaft. This vertical spindle passed through the central holes of both grinding stones without affecting the fixed stone, or bed stone, at all, but it did turn the runner stones. An iron rynd, fixed on the spindle, crossed the funnel-shaped hole in the runner and had its ends firmly anchored in the upper surface of the stone. The lower bearing of the spindle rested on a beam that the miller could raise or lower to adjust the cut of his stones minutely, according to information gathered by his celebrated miller's thumb ("rule of thumb") when he felt the texture of the meal. The device could also separate the stones entirely to keep them from grinding on each other, and so prevent their setting fire to the mill as they sometimes did.

Grain dribbled from a hopper and was guided by a spout, called the shoe, into the hole in the runner stone. It was moved outward by centrifugal force as the stone ground it. After leaving the stones' edges, the flour and bran were confined by a wooden casing,

the vat, that covered the stones. It could escape only down a chute that led to a wooden bin on the floor below. The flour and bran now needed to be sifted and separated into grades. This was done in the process called bolting. Silk bolting cloth was hard to come by, so in the most primitive mills the grind was sifted and resifted by hand in a temse, or sieve. By the late 18th century most mills had bolters to which little leather buckets fastened to a strap raised the mixed flour and bran by power taken off the main shaft. The bolter was a 16' long, gently inclined reel, usually octagonal, covered with a series of bolting cloths of increasingly coarse mesh; sometimes the lower one was made of fine wire screen. The ground meal entered the high end. As the reel revolved slowly, the finest flour fell through near the head into its own chute; common flour dropped at the mid-point, shorts or "canal," a mix of coarse flour and fine bran, left near the foot; coarse bran fell out of the open lower end.

The miller and his helpers had little time to loaf in the course of their work day. When grain arrived in a cart or wagon or in a sack slung over a horse, they had to hook a rope to it and haul it to the top floor of the mill. This was a hand-over-hand job in many small mills, with only a single pulley to help. They had to keep the hopper full, watch the grind, and change the gap between the stones, sometimes no more than the thickness of paper, as needed. Even when there was no hand sifting to do, the meal had to be measured, tolled, and bagged in the presence of the customer. A man wanted his own grain ground, not just an equivalent amount of some other man's grain. So the miller had to tag each man's sacks and grind them separately when that man's turn came. The strict first-come-first-served turn was each man's legal right and was always observed.

Millstones were made of ordinary granite or sandstone, quarried in full-size chunks. Each member of the pair had to be furrowed. The runner stone had furrows cut on the bottom and the bed stone had patterns cut on the top. Stones varied in size from four to six feet in diameter and weighed as much as one ton. Furrows varied in pattern; the early stones had curved grooves and the later stones had a variety of straight line furrows. The grooves serve as channels through which air can pass and carry off heat generated by friction during the grinding. They also serve as a path for ground flour or meal to escape.

The distance between the two stones could be adjusted slightly for each type of grain--corn, rye, wheat, etc.--and they had to be perfectly balanced and could not touch each other. Stones improperly balanced could ruin the product, damage the stones, and the friction could even cause a fire. Although the grooves on the stones rip and tear the outer husk of the grain, it is the flat areas that actually grind the husks and kernels into flour. A good miller kept his millstones "picked" sharp because dull stones ground coarse flour. Coarse flour was called "cakey" and tended to ferment faster.

Occasionally the miller had to shut down to recut the dulled grooves in the working surfaces of the millstones with a very hard chisel-headed hammer called a millbill. Itinerant stone dressers might also do the work, taking six to eight days to resharpen a pair of stones. The grooves had what might be called a check-mark profile, one side

nearly vertical, the other sloping. They were arranged variously, but always in such a way that the upper ones would shear across the lower, with the steeper edges opposed to achieve a cutting action. The most common arrangement was in groups of straight grooves, each group parallel to a tangent of the central hole: the bed stone was just slightly concave; the runner stone was convex but was almost imperceptibly flatter than the bedder. This made the stones bear hardest at their outer edges and therefore grind finest there.

While early millstones were quarried locally, later stones were often shipped from distant sources. French buhr stones were considered the best--and they were expensive. The French quarried them in smallish lumps from beds of softer stone, shaped them to fit together, and bound them with heavy iron bands into the thick disk shape of all millstones. Others stones were shipped from domestic quarries: granite of Rhode Island, sandstone of western New York and southeastern Pennsylvania being highly regarded. The better the stones, the less they had to be picked and trimmed to keep them sharp.