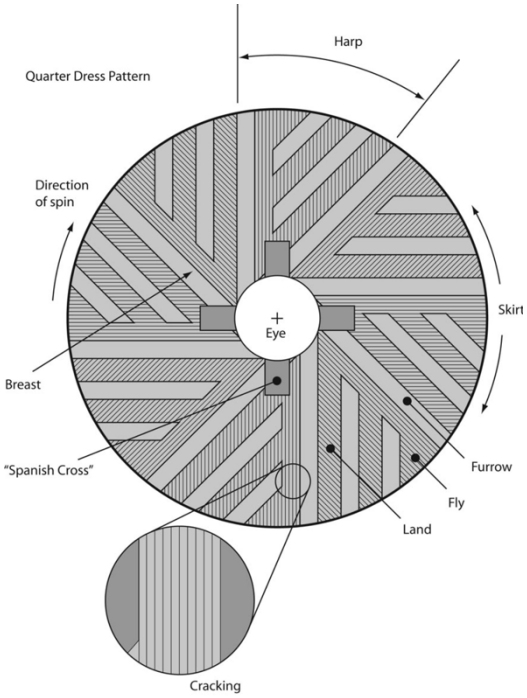
The Mystery of the Mill Stones or Why Do Fossils Make Finer Flour?

Contemplating the massive grind stones at Colvin Run Mill, visitors often have the understandable impression that the stones pulverize, abrade, and otherwise smash the tiny wheat berries to smithereens. We try to disabuse them of this notion. Not so easy. How can it be that these one ton rocks are oh-so-delicately cutting, scraping and gently grinding? It's a mystery worthy of investigation.

Close examination reveals that the top stone, the running stone, and the bottom stone, the bed stone, are "dressed" with indentations – large "furrows" and tiny "cracklings" or "feathers" – penetrating the flat surface, the "land."

We owe it to the Greeks (again!) who found that dressing grinding surfaces with patterns made for a finer grind. "Furrows" are grooves about one to three quarters of an inch deep set at a tangent to the eye of the stone. The back edge of a furrow is a sharp inclined plane cut at about an 80 degree angle; the front edge tapers downward at a 45 degree angle. The largest "master furrow" is followed by four or five smaller ones, the smallest called the "butterfly" or just "fly." The furrows become shallower as they reach the edge, or the "skirt" of the stone.



Groups of furrows, lands, and feathers are called "harps" that are arranged in different directions. A millstone could have six, eight or ten harps.

Harps on the bed stone run in the opposite direction from those on the running stone on top. When the running stone turns, its furrows cross those of the bed stone resulting a shearing action, like a pair of scissors. (Take a look at your scissors – shaped just like the back edge of a furrow!). The furrows and the feathers provide pathways for the product being ground to move to the skirt, propelled by the centrifugal force of the rotating running stone.

Now that we understand the features of a well-dressed millstone, let's follow the fate of the wheat berry or kernel of wheat on its way to become flour. Recall that the wheat berry is composed mostly of endosperm (83%), the source of white flour; fibrous brown bran (14%); and the fatty germ (3%).

From the eye of the running stone the wheat berry falls into a space between the stones called the “breast” or “dishing,” created by the running stone being slightly concave and the bed stone slightly convex. The berry immediately encounters the shearing action of the furrows of the two stones crossing each other in opposite directions, continually reducing the berry in size as it travels outward. The berry, now cut up into small particles, moves toward the outer edges where the stones are no more than a paper width apart and the “flouring of the stone,” occurs as the particles are ground into flour. The wheat berry trip takes about two and a half revolutions of the running stone.

Any type of millstone – granite, Cullen (black lava from around Mayen in the Eifel region of Germany) – can have these features. Colvin Run boasts hard, rough, porous French burh stones. Why are they better than your average rock?

As early as the fifteenth century, quarries around La Ferté sous Jouarre on the shores of the Marne River Valley about 70 kilometers east of Paris, were chiseling strong, dense, fossilized limestone that contained silica, the dioxide of the element silicon, found in quartz. This particular sedimentary rock is called chert – low grade flint. The area had been a fresh water lake teaming with algae (charophytes) and snails (gastropods) that left imprints – fossils - in the sediment that became, in the fullness of much time, exceedingly hard.

The tiny holes created by the fossils rip bran from the wheat berry in large flakes. Chert, being is less abrasive than other stones, didn’t pulverize the bran but adequately ground the soft endosperm Thus the bran flakes and germ could be more readily sifted from the ground endosperm to yield a whiter, finer flour. The term “burr” or “buhr” – seems to be derived from the old English ‘burre’ – prickly seeds of plants that stick to your shoe laces and pants - that was the basis for the term “bur” – a rough edge on metal.

Initially, buhr stones were hewn from a single block of chert, but by the late 1700’s large stones were hard to come by. Clever quarrymen then sold small blocks of chert fashioned in the shape of key stones so they could be pieced together in a circle. Millstone makers would construct a full-sized millstone with two rings composed of as many as twenty chert pieces. Harder pieces were placed on the outer ring that experiences more wear – and softer stones for the inner ring. These pieces are cemented together at the back and secured with an iron band that was “sweated” around the finished piece – that is the iron band was heated to red hot, slipped over the edge of the stone, and contracted as it cooled. To finish, a

layer of plaster of Paris was smoothed on the back with a slightly convex top with holes for lead weights used to balance the stone so it wouldn't wobble when rotating.

Although the first buhr stones arrived in the New World in 1620 for a Virginia windmill, they became famously popular in the mid-1700's as export demand flourished for super fine, white flour. Larger mills would use a pair of burh stones for white flour and other millstones for corn, buckwheat, and whole wheat flour.

When the US 1807 trade embargo curtailed French imports, an enterprising merchant, Christopher Fitzsimons, unearthed buhrstone near Louisville, Georgia in 1809. The following year he sent a sample to our old friend Oliver Evans who reportedly deemed Georgia buhrs as good or better than the French. Et voila! Georgia buhr business boomed with more than a thousand quarried. But not for long. When the embargo was lifted, French stones flooded back into the market. Zut alors! One Baltimore firm claimed to have 2,000 men laboring in French buhrstone quarries. More French buhrstones were reportedly in America than in France! Mon dieu!

Georgian burh tried another comeback in 1849, again receiving high marks from millers, but the trade ended with the civil war. Pioneers drew buhrstone from Flint Ridge in Ohio, an ancient site used by Indians to mine flint for weapons, tools and jewelry. Recently, sleuthing forensic paleontologists found that the Ohio chert was much older than the French, formed in a marine environment filled with invertebrate fossils – fusulinids (single cell organisms), pelmatazoans (stalked echinoderm like starfish and sea urchins), and brachiopods (hard shell animals). A prehistoric salty ocean in Ohio and massive fresh water lake in France. Who would have thought?

So there you have it. We have solved the mysteries of what happens between two millstones and how fossils made for finer, whiter flour. With a little biology, geology, and history thrown in for good measure.