Millstone Dressing Workshop at Miller's Bakehouse
July 30, 2016

The stars of this workshop were Dave Miller with his large size stone mill, Chris Kohler who brought his skills in balancing his own stone mill at *Grist & Toll*, Roger and son Larry Jansen who have built numerous stone *Jansen Grist Mills* and taught the skill of stone dressing together with Doug Mosel from the *Mendocino Grain Project* who is by now an advanced student of the craft, and Teng Vang from the *California Wheat Commission*, who described tests that we can use to monitor the flours produced.

Mills worked on were Dave's 39-inch Osttiroler dating from the 1990s with natural stone, and an 8-inch granite stone Meadows mill dating from 1984. Separately new millstone dressers using air hammer powered chisels, worked on a round of granite to bevel the edge, produce a pattern of furrows and lands, and to finely roughen the lands, so making it into a grist millstone. The roughing of the lands being the most important step in the re-dressing of millstones, since with use over time the lands become glazed by the materials in the flour.

An important aspect of Dave's mill was its large size inside a mill room with a rather exact amount of necessary space around the mill, to work. He had installed a custom gantry crane capable of lifting the top stone (1,000 pounds) from the mill, moving it to one side of the mill and allowing for the stone to be turned over for dressing. The mill room space required was therefore at least twice the overall footprint of the mill, plus additional work space around the dismantled mill. There was a glass viewing wall into the bakery, an entrance door from the bakery and an entrance to the outside. Dust control was essentially by covering the flour collection tub with a finely woven cloth, and the door to the outside was kept open during the milling, as ventilation. However, there is a separate ventilation system pulling fresh air in from a ceiling vent, and dust out through a louvered vent in a sidewall. In this way the mill room can be completely closed, and closed off from the bakery, so that there would be no risk of sparking a flour dust fire from bakery activities, while milling.

The concept for the workshop was to address the reasons why some stone millers are not pleasing their baker and pasta customers with fine enough flour; to such an extent that these millers resort to sifting out the bran and germ. The waste of nutrition and energy in such a process is ridiculous. Practically all the wheat dietary fiber, micronutrients and oils are contained in the bran and germ, which comprise approximately 15% of the whole grain and are preferentially sifted out. The endosperm contains primarily only the wheat macronutrients: starch and gluten-protein.

• Since the endosperm flour is needed to produce loaf volume and spongy texture, what must we do, for the stone mill to completely clean the endosperm from the bran, and become flour?

•Beyond maximizing the endosperm flour how do we also produce fine bran and germ particles to please the baker?

•What are the conditions for producing the larger bran and germ flakes to please the nutritionist?

The caveat is to also consider the nature of the particular wheat batch being milled. The bran on very dry wheat will be brittle and therefore will more easily break into smaller pieces than moist wheat, which instead produces large flakes on milling. Similarly the hardest wheat has brittle bran in comparison with softer wheat. Specific bread texture is determined by the nature of the gluten-protein and the starch in the chosen grain; the milling process does not change these attributes.

Our millstones are furrowed in straight lines tangentially to the central hole through which the grain enters the mill, with branch secondary furrows on the large mills. The furrows are deepest at the center and are made shallower towards the perimeter of the stone, so that there is essentially no depth at the outside edge. As the grains enter the furrows in the center they are forced towards the outside edge. Grains are broken up into chunks as they are forced against each other. The smallest grain pieces continuously escape onto the lands of the stone, where they are scraped between the closely set moving stones. *Note that the stones are never intended to touch each other during the milling process; the position is set before the milling begins.*

So far we have the idea that sharply edged furrows will enhance the chunking of the grain and therefore produce the bran in smaller pieces. The texture of the lands will be the determinant of just how finely we can scrape the endosperm from the bran. This time, Roger Jansen encouraged the beveling (rounding off) of the furrow edges in the small Meadows mill, so we shall have the opportunity to see whether this will cause larger bran flakes. The logic is that beveled furrow edges engage in a scraping process instead of an enhanced chunking process. As a compromise often seen, the back furrow edge is left sharply angled and the opposite side of the furrow is beveled or feathered. Both grindstones are similarly patterned in each case.

Currently the texturizing of the lands as practiced by the Jansens is by stippling with the air hammer driven multi-pointed square chisel. The process is continued until the surface is very finely roughened. The feel of the stone after the process is of touching velvet, or the finest of emery paper. The resulting 100% whole grain flour contains medium sized and very small bran particles from a hard red wheat, and a very finely ground endosperm.

We did not have the conditions to experiment with the *stitching* of the lands as practiced by Chris Leier, www.folepi.ca . The stitching consists of a series of fine grooves on the lands running parallel to the furrows. The process is French. There can be as many as 16 grooves per inch. Chris Leier manages this texture using an angle grinder. His experience is that this stitched texture of the lands is very effective in scraping the endosperm from the bran, and keeping the bran and germ in large flakes. He has noticed that this makes an interesting 100% whole wheat bread crumb relatively uncolored by the bran, but containing visible bran flakes. This is in contrast to 100% whole wheat flour containing the bran in fine particles, when the bread crumb will be colored by the bran with the bran flakes invisible. *It may well be that the stitched texture on* *the millstone lands is particularly suited to the milling of soft wheat, since this is the wheat generally available from farms in France.*

There is one simple test that we can quickly apply to wheat flour to determine whether it is baker-pleasingly fine, and that is to squeeze a handful of flour in the palm of your hand. The finest flour with clump together without falling apart, when your hand is opened. Coarsely ground flour will immediately fall away from the clump formed in the palm of your hand.

Teng Vang described a systematic way to test the *particle size distribution* achieved in the milling process. Using a set of 6 sieves and a catch pan he isolated particle sizes: >850, 850-425, 425-250, 250-180, 180-150, 150-75, <75 microns. Considering that approximately 15% of the whole wheat grain consists of bran and germ, a satisfactorily fine stone milled 100% whole wheat flour would have more than 80% of the flour particles less than 150 microns. Most of the bran particles are generally greater than 180 microns so desirably fine flour might have more than 85% of the particles at < 180 microns.

When the milling process is extreme, the starch granules in the wheat grain can be ruptured or damaged. The effect increases the water absorption capacity of the endosperm starch similarly to gelling the starch during cooking. Perhaps 5-10% starch damage in wheat flour is useful, since damaged starch is readily attacked by amylases during breadmaking to produce sugars for the leavening microorganisms. However excessive starch damage means that the flour absorbs an abnormally large amount of water and may produce a changed bread texture. Teng Vang introduced us to the *Solvent Retention Capacity* test. The solvents chosen are water for water retention capacity, and a solution of 5% sodium carbonate in water for a more sensitive starch damage indication. The values are generally characteristic for a particular variety of wheat so that changes in the water retention capacity, or sodium carbonate solution retention capacity can be indicative of changes resulting from the milling system.

Many other wheat flour tests are only indicative of wheat varietal character and are not very useful for demonstrating the effects of milling. For example, use of a 50% sucrose solution in the *Solvent Retention Capacity (SRC)* test indicates the amount of soluble pentosan present, which is a variable characteristic depending on the kind of wheat. Yet other tests are suitable only for refined flour testing because bran and germ would interfere with the result. However such tests are still useful if the whole grain flour is first sifted free from bran and germ; they often then give results that demonstrate the character of the gluten-protein. For example using 5% lactic acid as a solvent in the SRC test for protein character requires that there should be no bran present since it swells, and would give a false impression of the character of the protein.

In conclusion even before re-dressing the stones this time, Dave's large mill was found to be producing fine 100% whole hard red wheat flour, with 80% of the particles less than 150 microns, and 88% of the particles less than 180 microns. This suggests that the scraping of the endosperm from the bran is at, or very near completion and the bran and germ flakes are very small. The recorded 85% water retention capacity and 123% sodium carbonate solution retention capacity are high values, and suggest significant starch damage.

We have made a start in our understanding of fine 100% whole wheat flour production by stone milling. We have much more to learn.