PART THE FOURTH.

On the Process of manufacturing Grain into Flour, as practised by the most skilful Millers in the United States.

CHAPTER XIII.

ARTICLE 104.

THE PRINCIPLES OF GRINDING EXPLAINED, TOGETHER WITH SOME OBSERVATIONS ON LAYING OUT THE FURROWS IN THE STONES WITH A PROPER DRAUGHT.

THE end we have in view in grinding the grain, is to reduce it to such a degree of fineness, as is found by experience to fit it to make the best bread; and to put it in such a state, that the flour may be most effectually separated from the bran, or skin of the grain, by means of sifting or bolting. It has been proved by experience, that to grind grain fine with dull mill-stones, will not answer said purpose, because it kills or destroys that quality of the grain, which causes it to ferment and raise in the baking; it also makes the meal so clammy, that it sticks to the cloth, and chokes up the meshes in bolting; hence it appears, that it should be made fine with as little pressure as possible; and it is evident that this cannot be done without sharp instruments. Let us suppose we undertake to operate on one single grain, it seems to accord with reason, that we should first cut it into several pieces, with a sharp instrument, to put it into a state suitable for being passed between two planes, in order to its being reduced to one regular degree of fineness. The

planes should have on their faces a number of little sharp edges, to scrape off the meal from the bran, and should be set at such a distance apart as to reduce the meal to the required fineness, and no finer; so that no part can escape unground. The same rules or principles will apply to any quantity that will serve for one grain.

To prepare the stones for grinding to the greatest perfection, we may conclude, therefore, that their faces must be put into such order, that they will first cut the grain into several pieces, and then pass it between them in such a manner, that none can escape without being ground to a certain degree of fineness, whilst, at the same time, it scrapes the meal off cleanly from the bran or skin.

The best way that I have yet found to effect this, is (after the stones are faced with the staff, and the pick,) to grind between them a few quarts of fine, sharp sand; this will face them to fit each other so exactly, that no meal can pass them without being ground; this is also the best way of sharpening all the little edges on the face, that are formed by the pores of the stone; instead of sand, water may be used, the stones then face each other; they will then scrape the meal off of the bran, without too much pressure being applied. But as the meal will not pass from the centre to the periphery or verge of the stones, with sufficient rapidity, without some assistance, there must be a number of furrows, to aid it in its egress; and these furrows must be set with such a draught that the meal will not pass too far along them at once, without passing over the land, or plane, lest it should get out unground. They should also be of sufficient depth, to permit air enough to pass through the stones to carry out the heat generated by the friction of grinding; but if they have too much draught, they will not bear to be deep, or the meal will escape along them unground. These furrows ought to be made sharp at the feather edge, which is the hinder edge of the furrow, and the foremost edge of the land; this serves the purpose of cutting down the grain; they should be more numerous near the centre, because there the office of the

stone is to cut the grain, and near the periphery the office of the two planes is to reduce the flour to the required fineness, and scrape the bran clean, which is effected by the edges, formed by the numerous little pores with which the burr stone abounds. We must consider, however, that it is not best to have the stones too sharp near the eye, because they then cut the bran too fine. The stones incline to keep open near the eye, unless they be too close. If they be porous, (near the eye,) and will keep open without picking, they will remain a little dull, which will flatten the bran, without cutting it too much: but if they be soft next the eye, they will keep too open, and that part of the stone will be nearly useless; they, therefore, should be very hard and porous.

It is also necessary, that the face of the stone be dressed in such a form, as to allow room for the grain, or meal, in every stage of its passage between the stones. In order to understand this, let us conceive the stream of wheat entering the eye of the stone, to be about the thickness of a man's finger, but instantly spreading every way over the whole face of the stone; this stream must, therefore, get thinner, as it approaches the periphery, where it would be thinner than a fine hair, if it did not pass slower as it becomes finer, and if the stones were not kept apart by the bran; for this reason, the stones must be so dressed, that they will not touch at the centre, within about a 16th or 20th part of an inch, but get closer gradually, till within about 10 or 12 inches from the verge of the stone, proportioned to the diameter, and from that part out they must fit nicely together. This close part is called the flouring of the stone. The furrows should be deep near the centre, to admit wheat in its chopped state, and the air, which tends to keep the stones cool.

ARTICLE 105.

OF THE DRAUGHT NECESSARY TO BE GIVEN TO THE FURROWS OF MILL-STONES.

From these principles and ideas, and the laws of central forces, explained at Art. 13, I form my judgment of the proper draught of the furrows, and the manner of dress; points in which I find but few of the best millers to agree; some prefer one kind, and some another, which shows that this necessary part of the miller's art is not yet well understood. In order to illustrate this matter, I have constructed fig. 3, Plate XI. A B represents the eight quarter, C D the twelve quarter, and E A the central dress. Now, we observe that in the eight quarter dress, the short furrows at F have about five times as much draught as the long ones, and cross one another like a pair of shears opened so wide that they will drive all before them, and cut nothing; and if these furrows be deep they will drive out the meal as soon as it gets into them, and thereby make much coarse meal, such as middlings and ship stuff or carnel; the twelve quarter dress appears to be better; but the short furrows at G have about four times as much draught as the long ones, the advantage of which I cannot perceive, because if we have once found the draught that is right for one furrow, so as to cause the meal to pass through the stone in a proper time, it appears reasonable that the draught of every other furrow should be equal to it.

In the central dress E A, the furrows have all one draught, and if we could once determine exactly how much is necessary, I have no doubt we should find this to be the correct plan; and I apprehend that we shall find the best draught to be in a certain proportion to the size and velocity of the stone; because the centrifugal force that the circular motion of the stones gives the meal, has a tendency to move it outward, and this force will be in inverse proportion to the diameter of the stones, their velocities being the same, by the fourth law of circular

motion. E e is a furrow of the running stone, and we may see by the figure, that the furrows cross one another at the centre at a much greater angle than near the periphery, which I conceive to be right, because the centrifugal force is much less towards the centre than near the periphery. But we must also consider, that the grain, whole or but little broken, requires less draught and centrifugal force to send it out, than it does when ground fine; which shows that we must not, in practice, follow the theory laid down in Art. 13, respecting the laws of circular motion and central forces; because the grain, as it is ground into meal, is less affected by the central force to drive it out; the angles, therefore, with which the furrows cross each other, must be greater near the verge or skirt of the stone, and less near its centre than would be assigned by that theory; and what ought to be the amount of this variation is a question which practice has not yet determined.

From the whole of my speculations on this difficult subject, added to observations on my own and others' practice and experience, I propose the following rule for laying out a five foot mill-stone. (See fig. 1, Plate XI.)

1. Describe a circle with 3 inches, and another with 6 inches radius, round the centre of the stone.
2. Divide the 3 inches space between these two circles into 4 spaces, by 3 circles equi-distant; call these five circles draught circles.
3. Divide the stone into 5 parts, by describing 4 circles equi-distant between the eye and the verge.
4. Divide the circumference of the stone into 18 equal parts, called quarters.
5. Then take a straight-edged rule, lay one end at one of the quarters at 6, at the verge of the stone, and the other end at the outside draught circle, 6 inches from the centre of the stone, and draw a line for the furrow from the verge of the stone to the circle 5: then shift the rule from draught circle 6, to the draught circle 5, and continue the furrow line towards the centre, from circle 5 to 4: then shift in the rule to draught circle 4, and continue to 3; shift to 3, and continue to