

## Power Equals Power: Class and Milling Technology through History

Ken Albala

**ABSTRACT:** This paper traces the evolution of milling technology and various sources of power. It argues that those who owned the means of production also held literal power and this had a direct impact on the type of bread produced and its role in society.

Playing on the two senses of the word power, meaning both source of energy and exercise of authority, this paper equates the two, showing that Marx's division of history into dialectical epochs was less rooted in simple class struggle than it was control of the power source to process food. This paper focuses on milling technology to argue that in the West how one ground grain and who controlled this process essentially determined who held power. A grand overview follows human and animal power in the ancient world with hand querns and stone mills, to water and windmills of the feudal Middle Ages, to the steam powered mills like New Albion, to the electric and nuclear-powered steel roller mills of the modern era. I will argue that elite classes exercise power primarily through their monopolization of the means of production and in this case it is simply who owns the power source to make bread. Implicit in the argument is that the fewer the people in control and the more expensive and technologically complex the source of power, the worse the bread from a gastronomic vantage point, as a rule through history. Ironically, bread becomes less important as a staple as well, as the recent backlash against wheat gluten suggests. At the same time the rise of small scale artisanal milling and bread making suggests a backlash against corporate power.

The focus here is on wheat regimes in Western Culture, which are in many ways inherently distinct from other grain staples. This is because rice is husked and polished but is primarily eaten in whole form and maize, while processed, is done so at the local decentralized level within the household until the 20th century. When other starchy tubers constitute the staple, such as manioc or sweet potatoes, these can demand a high level of processing as well, but likewise this was done at home. The centralization of milling power and conglomeration of the industry controlling it maybe not coincidentally be connected to the power of the West across the globe in the modern era.

Grist milling technology has a long history, older than civilization itself. The process of milling ultimately determines the quality of bread and its social value, which is a measure not of price or rarity but a reflection of the time and energy spent in production. Or put another way the

value of bread is power congealed in the edible product. A finely milled and bolted white flour may confer status on the consumer, though once that can be achieved industrially, the status of brown, whole grain bread made from coarsely milled wheat suddenly rises in stature. Ultimately, there is no objective or universal way to assess *good* bread since it is entirely dependent on the social and economic context of the society that produces it. Some periods in history prefer delicate sweet little dinner rolls, others huge rustic country loaves. Naturally within any society there will also be a range of preferences, some personal and some aligned with social class, region or ethnicity.

Rather than make qualitative judgements regarding milling technology, it is more important to explore why people in the past liked the bread they did. What factors led to such radically different preferences? Thus we will look closely at milling to examine who actually ran the mills and what was the nature of labour expended. Why have there been fewer and fewer millers per capita as we get closer to the present? How did milling technology influence individual behaviour and why did people judge different types of bread, largely by its texture and colour? How is it that milling technology designed to provide cheap and abundant bread in the modern era has undermined the social value of bread so thoroughly that for the first time in Western history there is a serious crisis threatening to topple bread from its central role as a dietary staple.

The oldest milling technology, as opposed to simply pounding grains in a shallow depression or hollow log, is known as the saddle quern, which according to recent archaeological finds, predates the domestication of wheat. That is, people ground forms of wild wheat, emmer, barley and other grains. The saddle quern is simply a curved stone with a coarse surface on which a handful of wheat is placed. The person kneels over it using body weight for leverage. There is another cylindrical stone with which the grains are crushed and sheared after they have been threshed and winnowed. It is time consuming and laborious, taking a considerable portion of the daily labour of a person for whom wheat is the staple. Naturally the larger the family the more labour required to grind the daily bread, or perhaps weekly bread if a large loaf is being baked. In prehistoric and Neolithic households, every family would have owned its own saddle quern to process dried stored grain as needed. Houses at Çatal Huyuk in Turkey have storage spaces for grains adjacent to the kitchen located at the centre of the living space. Here every household had its own milling operation and the power derived solely from calories expended in human force. The family is the

productive unit and determines the social value of bread which is their own.

The bread could be baked in a simple earthen oven but was more likely made into flatbreads cooked on a stone, ceramic disk, or inside a tannur. At this point, practically all people were millers and bakers. There was relatively little specialization of the economy and every person was also a jack of all trades. So the farmer, the miller and the baker are all the same person or at least within the same family if there is division of labour according to gender. It is often assumed that men worked the fields and women ground the grain and baked the bread, though this model is increasingly being challenged. Given the limitations of technology, everyone's bread is essentially the same, and if there are subtle differences in bread, few people know about it because consumption is mostly within the household or with guests.

A rotary quern is a slightly more advanced technology since it involved two stones: one convex, the other concave, into which notches are cut that crush the grains when poured in through a hole in the top, as the upper stone is turned with a handle. It takes about one half hour to grind enough grain by hand for a two pound loaf. There are wildly divergent estimates about caloric needs and how many pounds of bread would have been required to feed a labouring family, but even if every person in a family of four ate two pounds a day, it would still only take one person two hours to grind enough grain to feed them. And then the bread would be formed, kneaded, baked. It is a lot of time and energy, but by no means the entire working day.

Most importantly, each family owned the means of production. The mill itself was easily acquired. The labour to produce the staple food is controlled entirely by the family, usually at every stage from growing wheat to putting bread on the table. As economies began to specialize, one individual or family might choose to focus exclusively on bread and then provide it to others in exchange for different goods and services. But there is inherently no change in the nature of labour here. Whoever makes the bread is necessarily an artisan because they are limited by the milling technology available, which is for the most part small scale and human-powered. At this point, one specialized producer could make a product perceived to be superior. There is no historical record of it, but it is likely that whoever spent more time and care in milling would create a product more valued by consumers.

The greatest change comes from the use of larger flat mill stones that are turned by animal, an ox or donkey, harnessed to a capstan — the bars extending out of the wheel head. Notches are cut in each stone in opposite directions so the grain is completely ground as the wheels turn. These demand a serious investment in the stones and the maintenance of an ox, donkey, or other draught animal. It also demands further specialization, which means that the individual is usually no longer the farmer who grows the wheat. This person might simply grind the grain for others,

or might also bake it, but in general someone else is providing the wheat. Thus the technology has spurred on specialization of labour and an increase in scale. And of course the miller now must satisfy consumers' demands, they are able to employ much greater discretion in their purchase. There will be a clear impression of well-made flour — based entirely on the expertise of the miller, how finely he can grind, how thoroughly he bolts the flour. It is entirely a matter of the labour and care he puts into the product.

Around the first century BC, the Greeks and then the Romans began to use water power to drive the stones. These could produce vast quantities of flour from wheat grown by slaves on enormous latifundia, the ancient equivalent of a plantation. The earliest forms, used by the Greeks, were horizontal water wheels fitted with paddles that sat in a river bed and directly turned a shaft of a millstone above it. Imagine the shaft coming through a fixed wheel on a platform while the upper wheel turns. A really swift running river is necessary to drive it. Thus, it is usually located in the hills. You can't control the speed and it is difficult to stop.

More complex and efficient is the vertical water wheel that turns mill stones. The ancient architectural theorist Vitruvius describes these — after discussing the water wheel itself, which is essentially a wheel with buckets attached affixed into a running stream below or a sluice (or mill race) above so the force of the water filling each bucket turns the wheel. The undershot wheel is less efficient because the wheel has to overcome the resistance of the water since it is sitting in the stream. The overshot drops the water from above so you get the force of gravity as well. Then there are, as Vitruvius describes, 'mill wheels turned on the same principle, except at one end of the axle [of the water wheel], a toothed drum is fixed. This is placed vertically on its edge and turns with the wheel. Adjoining this larger wheel there is a second toothed wheel placed horizontally on which it is gripped. Thus the teeth of the drum which is on the axle, by driving the teeth of the horizontal drum, cause the grindstones to revolve. In the machine a hopper is suspended and supplied the grain, and by the same revolution the flour is produced'. It's a simple gear mechanism that turns a shaft connected to an upper millstone while lower one or bed is fixed to the floor. The ground wheat pours out the side where the two stones meet.

Around the time of Jesus, Antipater of Thessalonica wrote these lines which describe exactly this kind of mill. 'Hold back your hand from the mill, you grinding girls; even if the cockcrow heralds the dawn, sleep on. For Demeter has imposed the labours of your hands on the nymphs, who leaping down upon the topmost part of the wheel, rotate its axle; with encircling cogs, it turns the hollow weight of the Nisyrian millstones. If we learn to feast toil-free on the fruits of the earth, we taste again the golden age'.<sup>1</sup>

Obviously, this technology not only produced flour at a much greater pace and volume but most importantly it was

very expensive to build. The miller was either the state which built communal mills to supply the armies and provided bread as a form of social welfare to the cities. There were also private mills that contracted for the state or took on private clients who were middle men, grain speculators, and people who went into the grain trade as a business. The bumbling nouveau riche Trimalchio in Petronius' *Satyricon* was a former slave who made a fortune in grain speculation. In terms of labour, it was now not only specialized but also fairly elite. Milling had become an industrial process that could only be undertaken by a wealthy investor. Likewise, baking was on a large commercial scale. There was a great deal of competition and consumers could choose the best forms of bread. We know the lighter and springier the bread, the more highly valued. This is a reflection of the labour it took to design these superior mills.

The Romans milled grain on an enormous scale. The remains of a massive complex exist, known as Barbegal, dating from the second century AD, a few miles north of Arles. It contained 16 mills on a steep hillside aqueduct, which could produce about 4.5 tons of flour a day. That was probably enough to feed the whole city.

This kind of watermill was still used after the fall of the Roman Empire, but as the infrastructure of the slave run farms fell apart and the roadways fell into disrepair, and the demand for bread in cities dropped dramatically, and it became less common. There simply were not the investors lined up to continue this scale of operation, in western Europe at least.

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### Milling in the Late Middle Ages

It was not until after about 1000 that watermills began to proliferate again in Western Europe. Slavery had been replaced with various forms of serfdom, in which people were bound to the land but otherwise practiced subsistence agriculture, providing mostly for their own needs and then working several days on their lord's demesne, or his own personal plot which was usually for his household use or for trade. Medieval gristmills tend to be smaller than the ancient Roman ones. They also began to harness wind power with windmills, though you need to be in a windy spot and the entire building needs to be on an axis so it can be turned to face the wind. Both these technologies are very site dependent, you can't just put them anywhere. The gristmill is still a large and expensive investment. The stones are about 4 feet in diameter and weigh about a ton each. For the most part they were either owned by the feudal lord who would charge a fee for his peasants to use the mill. In England these are called soke rights. Or it might be owned by an independent miller, specialising in this trade, and usually someone fairly well off, but still a labourer. This kind of investor tends to operate near cities where there is a large demand for flour and professional bakers. The feudal

mill tends to be more rural, and the bread is usually baked in a communal oven by the villagers themselves.

Toward the later Middle Ages and into the early modern period, millers were increasingly upper middle-class professionals and their work was subjected to detailed scrutiny. If the stereotype bears any truth, they were generally thought of as cheats, skimming off flour from customers and keeping spilled grain for themselves. There were various punishments for unscrupulous millers, just as there were for bakers in the Assize of bread. So again, the value of the bread comes from the care put into milling, and nothing was more reviled than someone who cheats or adulterates the flour or who cuts corners.

Chaucer's Miller in the *Canterbury Tales* was a gruff, bawdy red-haired guy that liked to wrestle and break open doors with his head. 'But Wel koude he stelen corn and tollen thries; (that is charge three times the price) And yet he hadde a thombe of gold, pardee'. That latter line is often explained by the fact that millers test the quality of the flour with their thumb, and that a golden thumb is perhaps just as rare as an honest miller. But it may also mean that he puts his thumb on the scale to weight it down and cheat customers.<sup>2</sup>

Another persistent association with milling is how labour intensive it is. Here Shakespeare offers an interesting passage that shows explicitly how value is generated by labour, or as he calls it tarrying. This is from *Troilus and Cressida* where bread making is used as a metaphor for patience and the need to go through ever necessary step carefully without haste.<sup>3</sup>

Pandarus. He that will have a cake out of the wheat must needs tarry the grinding.

Troilus. Have I not tarried?

Pandarus. Ay, the grinding; but you must tarry the bolting.

Troilus. Have I not tarried?

Pandarus. Ay, the bolting, but you must tarry the leavening.

Troilus. Still have I tarried.

Pandarus. Ay, to the leavening; but here's yet in the word 'hereafter' the kneading, the making of the cake, the heating of the oven and the baking; nay, you must stay the cooling too, or you may chance to burn your lips.

We might not think of baking per se as an apt metaphor for extraordinary patience but making bread through its various steps was extremely time consuming. The most interesting thing about the passage is that it assumes one person would do every step. Shakespeare may intentionally have included this because the play is set in the ancient world, or he may have just made a mistake. His audience might rightfully have wondered how the same person could

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tarry over the milling and bolting as well as the leavening and baking.

In the same play the soldier Ajax uses insults someone by calling him a ‘cobloaf’ referring to a misshapen bread, obviously the result of mishandling, failed rising or lack of patience.<sup>4</sup>

The value of bread in the early modern period was partly determined by the grain used, and hence the colour of the bread but also the fineness of the crumb which results from the degree of bolting. So whiteness and lightness were associated with quality in bread. The coarser and darker the bread the lower the class that eats it. Tobias Venner for example said that wheat grains are made of four parts. The pollen is very fine and can be used for weak people ‘but if any such use it, they are more curious than judicious’. Better is similar, which makes the best bread and is the most nourishing and ‘in greatest use among the better sort of people’. But secundarium is for yeomen. And the branny part (furfures) only fit for the poorest people in dire necessity, but normally is most fit for dogs.<sup>5</sup>

The early modern technology really hadn’t changed much since ancient times either, nor was it terribly different in the colonial period. In fact, there are excellent reconstructions of working mills through the United States. One exists at Philipsburg Manor in Sleepy Hollow, NY which was more or less a feudal patroonship. The owners milled grain for their tenant farmers running from Yonkers all the way up the right side of the Hudson. There are similar mills in Mount Vernon, and the 17th century Jenney Grist Mill in Plymouth. These reconstructions show the working technology of a mill that is 18 centuries old.

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### The Industrial Era

At the end of the 18th century the American inventor Oliver Evans developed a completely automated mill, the third granted US patent in 1790, and one was actually built near New Castle, Delaware. It was still powered by water wheels, as were all colonial mills. People’s interest in it was precisely that it took no human labour to operate.

The really important change came with the application of steam power, which means you can move the factory anywhere, but you also need someone fantastically wealthy or a corporation and investors to operate it. As Karl Marx wrote ‘The windmill gives you society with the feudal lord: the steam-mill, society with the industrial capitalist’.<sup>6</sup> The first example is the infamous Albion Flour Mills in Southwark across the Thames from London, established in 1786, not far from where Blake penned the line ‘Dark Satanic Mills’ in the poem Jerusalem. It was the first steam driven flour mill-factory, with engines designed by James Watt and entrepreneur Matthew Boulton and machinery by the Scots engineer and designer John Rennie. Each of 20 pairs of millstones could grind 10 bushels (That’s about 60 pounds) of wheat an hour with 150 horsepower engines. That would be 600 pounds times 20 equals 12,000 pounds or 6 tons an hour, in a 12-hour day is 72 tons of flour, a lot

more than the Roman’s four and a half. Erasmus Darwin called these the most powerful machines in the world.

There was great resentment on the part of traditional millers, whose jobs were threatened. They accused the factory of putting filthy ingredients in the flour to cut costs. ‘The millers, themselves best aware of what roguery might be practiced in their own trade, spread abroad reports that the flour was adulterated with all sorts of base mixtures’. In 1791 the whole factory burnt down, whether it was intentional arson or not, the millers were very happy about it. The poet Robert Southey wrote ‘and before the engines had ceased to play upon the smoking ruins, ballads of rejoicing were printed and sung on the spot’.<sup>7</sup> ‘Success to the mills of ALBION but no Albion Mills’. This was exactly the kind of class struggle Marx had in mind formulating his theory of the dialectic conflicts that propel history forward, but importantly it is ultimately a struggle over power, how grain is processed and who owns and controls that process.

In the 19th century there were many complaints against the changes that were happening to bread, the most infamous of which was Sylvester Graham, the whole wheat promoting minister, after whom graham flour is named and the eponymous cracker. Less well known was the English journalist William Cobbett who complained about people spending their hard-earned savings on mass-manufactured bread when it could be made more cheaply at home and with purer ingredients. In his mind there was also something very wholesome about women’s domestic duties — he thought it would lead to the breakdown of society if women were working in factories and then spending their wages on poor-quality bread.

In 1821, he wrote in *Cottage Economy*, ‘Give me for a beautiful sight, a neat and smart woman, heating her oven and setting in her bread! And if the bustle does make the sign of labour glisten on her brow, where is the man that would not kiss that off, rather than lick the plaster from the cheek of a duchess?’<sup>8</sup> His implication, apart from the sexism, is that true quality derives from an honest kind of labour, not a factory.

Nonetheless, steam driven mills, although perhaps smaller than Albion, were the way of the future. Added to that, the Repeal of Corn Laws 1846, basically instituting free trade, meant that tons of foreign grain were imported into Britain, so the raw material was cheap. The steam roller mill was invented in 1865, and in 1875 in the US there were developed ways to blow the bran off the wheat middlings using streams of air. The steel rollers could also handle the hard wheat varieties grown in the Midwest prairies. The process does destroy nutrients and vitamins, because the grains are heated in the process, but it is much quicker and gives you a much finer flour. It also meant that the entire process was centralized in one huge milling factory, the grain is shipped there and then shipped out again in the form of flour, which would not have been possible without railroads. This accounts for the huge

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corporate milling operations in Minneapolis, like General Mills. Then comes bleaching the flour to make it whiter, adding bromates to replicate time in storage and to make the bread fluffier, and fortifying it with the vitamins that would have been there if not milled this way. In the U.S. thiamine, riboflavin, niacin, and iron were by law required to be added in 1941. This is true of whole wheat flour as well, which despite the perceived health benefits just has some of the bran added back in to give it colour and texture, but it's still basically white bread. The germ is still missing, otherwise it would have a shorter shelf life.

In the mid 20th century this Wonderbread was perceived as a marvel of modern technology, though it used less human labour, it was considered superior because of the ingenuity that made it fluffy soft aerated rectangular pre-sliced white bread. This was exactly what only rich people could have afforded in the past. How then could this iconic American loaf suffer a complete reversal of fortune in the latter 20th century?

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### The Post War Era

Ironically it was advanced technology that made white bread cheap and abundant, and therefore less desired as a mark of status. Oddly, older technologies, using stone ground wheat, slow fermentation with wild yeast, baking with wood fired ovens, provided irregular, personal, artisanal loaves whose higher price and relative scarcity lent them a new cultural caché and value. It was the largely the labour inherent in the process, or at least as projected by clever marketing, that was the real source of value in artisanal milled flour and bread — the perception that an individual was able to use bread as a vehicle for creative energy in order to express, as Marx called it, the species being, that unique ability of humans to derive pleasure from labour when it is unfettered by external demands of business, capitalist bosses, profitability, stockholder's demands. This artisanship is often merely a clever marketing ploy in a capitalist society, but that is not to say there aren't serious craft bakers and increasingly millers with nonstandard wheat varieties and pre-industrial techniques in practice today.

We are experiencing a second wave artisanal baking right now, and increasingly milling as well, which in a sense is merely upping the ante of craftsmanship to distance itself from what is now ubiquitous and often very mediocre vaguely craftish looking bread, sometimes industrially manufactured and sold in supermarkets. In other words, it takes more than handmade bread now; people want to know how the wheat is grown and milled.

Faux artisanal or not, the social value of bread is still determined and inextricably bound to milling technology. Even though we are completely alienated from the milling process, and since the entire industry has been conglomerated, the only way to express greater value is to grow the wheat locally, use older strains of wheat, simpler and more labour-intensive technologies. We are about to enter a period of new high end artisanal flours and in the end breads — which will be the new marks of distinction in years to come. Until perhaps a new technological breakthrough can completely transform milling and bread production again.

Whatever the future holds it is nonetheless the case through history that milling and the power source used to accomplish it are a reflection of who holds power and that the social value of bread is a manifestation of the labour expended in producing it. The artisanal bread movement may in some way herald the loss of power for industrial food production and a return in some measure to small scale production and a return to small scale local farming, milling and baking of bread.

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### About the author

Ken Albala is Professor of History at the University of the Pacific and founder of its MA program in Food Studies. He is author of many academic monographs, single-subject food histories, and cookbooks as well as editor of encyclopedias, handbooks, anthologies, and several food series. His latest book is *Noodle Soup: Recipes, Techniques, Obsession* and he is currently working on a new project about *Walking with Wine*.

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