C O N T E X T

Brick-Making in the Nineteenth Century

Context – Brick Making in the 19th Century

While bricks have been produced for nearly 10,000 years, and fired brick for approximately 5,000 years, brick-making only became truly regulated, productive and efficient in the nineteenth century. It was during this period, at the height of the Industrial Revolution, that the technological advances were made that allowed bricks to be produced in quantities never before possible.

It is within this context, of the great advances and production in England, as well as in the eastern and mid-western United States, that the story of Manitoba's brick industry must be placed. For our own localized history is essentially an expression of those earlier traditions. Two excellent overviews of brick-making activity, from England and the mid-western United States, provide the necessary background: Kathleen Ann Watt's *Nineteenth Century Brickmaking Innovations in Britain: Building and Technological Change*, (University of York, Institute of Advanced Architectural Studies, 1990); and Andrew Charles Stern's *Cream City: The Brick That Made Milwaukee Famous*, (University of Georgia, 2015). Extracts from these studies are quoted here in some detail, given their reliability and readability, and because so much of this information will resonate upon reading following sections on Manitoba's brick-making history.

Activities and Characteristics of the Brick Yard

Ms Watt provides the following observations about a typical nineteenth-century English brick yard: "Little capital … was required to begin brick-making operations when hand methods were used. As local building projects created a sufficient demand for bricks, new works often were opened to supplement the supplies available from permanent kilns. Once the [clay] was extracted to a certain level, or building activity

A collection of 19th-century bricks, from yards of the Hudson River area of New York State. These bricks have come out of pressing machines, revealed by the tell-tale indentations and inset company names. The indentations, which allowed for more mortar application during construction, were called frogs – a term derived from the Dutch word "kikker," the term used in that language for the depressed section of the wooden box in which bricks were formed in early brick-making technology, and which was translated into English as the word frog. (Courtesy WikiCommons) slumped, many operations closed down and the land was returned to cultivation.

"A predominant feature of the traditional industry was its inherent seasonality. For the most part, the entire process of brick-making was carried on in the open air and was subject to the uncertainties of the weather. The clay usually was dug in the autumn or winter and left in heaps to break down the lumps and make it more easily worked. Tempering and moulding only commenced in March or April after the danger of winter frosts had passed. From then until the following autumn, brick-makers worked extremely long hours, sometimes as much as thirteen hours a day, to maximize production during the spring and summer months.

Mr. Stern's *Cream City: The Brick That Made Milwaukee Famous*, provides additional details on clay preparations: "following [extraction], and ideally, weathering, the clay was tempered and mixed. If the clay contained gravel or stones, it was often screened or passed through a crusher to remove these elements. Tempering involved adding water to the raw clay and allowing it to sit for 12 to 48 hours to soften before mixing. The amount of water added varied depending on the consistency necessary for the type of brick to be produced. Soft-mud brick required a different consistency than stiff-mud. Most commonly, vats of clay and water were filled and tempered on alternate days to allow for a continuous supply of clay ready to be mixed. Mixing was a particularly important step, as improper mixing often resulted in bricks that delaminated quickly [fell apart in layers] when exposed to harsh weather. It was during this step that sand, coal, and other stabilizers were also added to the tempered clay to help prevent uneven shrinkage and cracking."

Ms Watt continues: "Before burning, newly moulded "green bricks" usually were stacked in open-air hacks to dry for up to six weeks, protected from the weather by a covering of straw matting, tarpaulins and, later, wooden boards with louvres [see a following section on brick drying]. Attempts to hurry the process and burn the bricks before they had dried sufficiently jeopardized the soundness of the finished products. In southern [regions] the bricks were burned in "clamps" also open to the weather

The construction between 1850 and 1859 of All Saints, Margaret, London, to the designs of architect William Butterfield, has been noted as a pioneering example of the High Victorian Gothic style and extolled especially for its use of brick in a major public building. When most Gothic Revival churches of the mid-nineteenth century had typically been built of grey Kentish ragstone, Butterfield's use of brick, in a variety of colours and finishes, was revolutionary. Butterfield was said to have felt a mission to "give dignity to brick."

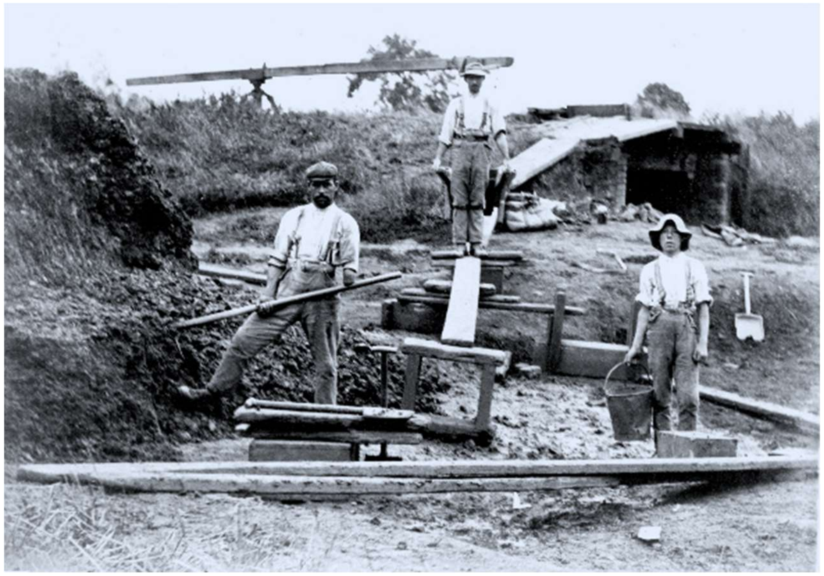
rather than in [scove] kilns, thus potentially exposing the outer layers of bricks to additional damage [see a following section on kilns].

“The system adopted for the organization of work in the traditional brick-making industry was particularly suited to small-scale, temporary enterprises with low capital investment. In most areas the brick-field owner hired a brick-master at a price per thousand bricks to superintend the site and take full responsibility for the output of the operations. He in turn contracted with moulders to temper, mould and hack the bricks. Each moulder then hired his own "gang" of subsidiary labourers and acted as their employer.

An old single-brick mould, the type used throughout the 19th century for the production of bricks at small yards.

“In traditional hand brick-making, the thoroughly tempered clay was carried in lumps from [a] pugmill to the moulders' tables where it was shaped into bricks by one of two methods depending on the characteristics of the local clay and on regional traditions. In "pallet-moulding" (or "sand-stock moulding"), sand was sprinkled first into a wooden- or brass-lined mould box, often divided into several sections, before the clay was thrown in with considerable force and pressed into the corners. The excess was scraped off the top with a "strike" and the finished bricks were turned out onto a pallet board and wheeled away to the drying sheds, while the mould was sanded again and made ready for use. In the less common "slop moulding," the mould box was dipped in water before it received the clay. After striking, the entire mould containing the bricks was carried to the drying floor while a new mould was dipped in water and the process was repeated.

“Moulders traditionally were considered the most skilled workers in the brickfield … based on "the knack with which he throws or drops the soft clay into the mould, so as to fill up every corner." Hand moulding undoubtedly required accuracy, speed and a great deal of strength to keep up the necessary movements for a ten- to thirteen-hour day. However, the abilities of the other brick-making labourers were equally crucial to the success of the operation. The temperer, who supervised the preparation of the



Top left: This image of re-enactors at a recreated small brickyard in Britain shows the shaft of a pugmill (where clay was mixed with water) behind the three brickyard workers pausing in their labours as they extract raw clay from the site. (Courtesy WikiCommons)

Below left: This image, of the same re-enactors as above, shows the brick-maker at his moulding bench, taking clay from the heap provided to him by the temperer, the person responsible for mixing the clay to its required consistency. (Courtesy Wiki-Commons) clay, needed both knowledge and judgement to bring the paste to the optimum consistency. Even the supposedly unskilled "walk-flatter" … played an important part in the moulding operations. This was the person who brought the clay in brick-sized lumps from the pug mill to the moulding table. One brickfield proprietor reported that this seemingly simple task "required great practise and nicety to give such a wedge-like form to each lump of clay as that the moulder can with one throw force it equally into all parts of the mould." Another brick-master commented on the importance of burning: "There is more skill wanted in burning bricks than in any other part belonging to it."

"The colour of bricks depended upon three variable factors: the composition of the clay, the intensity of the heat and the amount of air they were exposed to during burning. The presence of iron oxide in different proportions in the clay was responsible for the various shades of red in bricks produced in many parts of the country. Under-burning and exposure to air also changed the colour of the bricks, especially those burned in clamps. Those on the outside of the clamps, the soft, porous "place" bricks, often were red because they had received inadequate or uneven heat during burning or because they were in constant contact with the air."

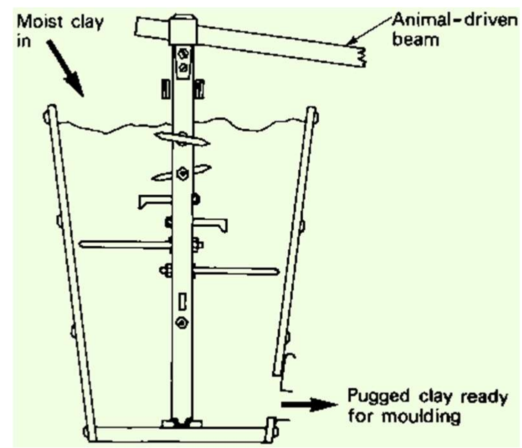
Ms Watt adds: "From the end of the eighteenth century, bricks made in the southern counties and supplied to the London market were classified under three main types. These were *maim* bricks, made from a mixture of clay and ground chalk in imitation of the superior marl clays which contained a large amount of natural carbonate of lime; washed bricks made of clay washed in a wash mill to remove unwanted stones and with perhaps a small amount of calm added; and common bricks made of unwashed and usually unscreened clay with nothing added to improve its quality.

"The method of clamp burning … produced additional subdivisions in the types of bricks according to where they were placed in the clamp and how they were affected by the fire. For example, the best and most expensive bricks were made of well-mixed calm earth and evenly burned. "Seconds" also were good quality, hard-burnt bricks, but they were slightly uneven in colour or had small blemishes on their surfaces.

"Shippers" and "stocks" were either misshapen by accidents in the fire or more blemished than the others, but they were suitable for most ordinary work. Finally, "grizzles" and "place" bricks were under-burnt and soft and were suitable only for inside work or garden walls. The third category included "common stock" bricks, basically sound but with an irregular surface which was not suitable for facings, "rough stocks" which were hard burnt but extremely uneven in shape and colour because of the stones left in them, and the cheapest in price, the "common place" bricks.

“When kilns were used instead of clamps, the classification was not as extensive because the bricks were relatively equally burned. Here the various qualities depended more on the selection and preparation of the clay. "Front bricks," for example, were made of carefully selected, finely ground clay, "rubbers" were run through a wash mill and mixed with sand, while "common bricks" were made of clay as it came out of the ground with little preparation other than tempering with water. Most other variations came from the arrangement of the bricks in the kiln. Those nearest the fire became vitrified and blackened, while mottled or striped colouring was the result of the bricks resting upon each other, thus allowing some surfaces to be only partially exposed to the heat.”

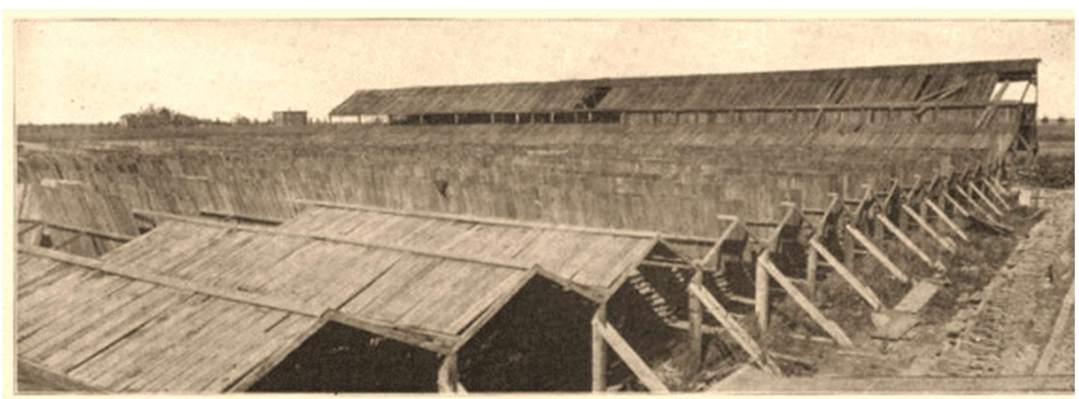
These two images show a pug mill on a brickyard site (above left, in the background) and in a technical cross-section drawing (below). The pug mill was a wooden tub with horizontal knives or blades attached to a revolving central shaft and activated by a horse harnessed to an attached beam. The knives cut and kneaded the materials as they were thrown in at the top and forced out at the bottom as a homogenous paste. (Courtesy Wiki-Commons)



Brick Drying Processes

The fourth step in the brick-making process, following extraction, mixing and moulding, was drying. This essential step ensured that the prepared brick was allowed sufficient time to reduce its water content; bricks that were too moist had a tendency to disintegrate and even explode in a kiln.

Andrew Charles Stern, in *Cream City: The Brick That Made Milwaukee Famous*, outlines the basic precepts and technologies that attended nineteenth century brick-drying processes: "Three methods of drying were used in brickyards [in Wisconsin] – open-yard (hack drying), pallet-racks and artificial heat dryers. The first method was most widely used, as it required the least expense. These bricks were taken from their moulds and placed flat in the yard to dry for about a day, after which they were stacked on edge in piles known as hacks. These hacks were ten to twenty courses of brick in height and allowed to dry for a period of one to two weeks, depending on weather conditions. The hacks were covered with wooden tops and canvas sides to protect them from inclement weather. Because bricks tended to crack when exposed to direct [sunlight], rain, or freezing temperatures, many thousands of bricks annually were lost in open-yard drying. After two weeks the bricks were ready to be burned.



An impressive collection of brick-drying sheds at East Grand Forks, Minnesota, ca. 1900. The rudimentary nature of the structures is apparent here. (Courtesy WikiCommons)

“Pallet drying was another method [employed at this stage of brick production]. Green bricks were placed on wooden pallets under sheds. These bricks tended to dry in a more uniform manner than open-yard drying, but although protected from rain and extreme heat, were as frequently destroyed by frost as open-yard bricks.

“Drying brick with artificial heat was a process developed later in the nineteenth century. It was beneficial because of the ability to be used in cold [temperatures], allowing brick to be dried regardless of weather. Artificial heat usually required 24 to 36 hours for the brick to pass through the drier before they were ready for firing. However, this method was more expensive due to added fuel costs. These were negated at some of the largest yards, which constructed driers recycling heat from firing kilns.”

Impressive brick-drying sheds at Grand Forks, British Columbia, 1930. (Courtesy WikiCommons)

While creative attention in the nineteenth century was more focused on brick pressing and forming, as well as on brick-firing technologies, there were still some people attending to improvements in brick-drying approaches and technologies. The key issue was to reduce the time taken out of production by the long drying stage. One English inventor suggested a system for drying bricks using waste heat from the kiln, while another brick-maker reduced the drying time to twenty-four hours by passing green bricks through a steam-heated tunnel on rolling trays.

The greatest opportunity to reduce brick-drying time actually came with an insight into the earliest stage of brick production – the selection of the brick material. Thus certain inventive minds turned their attentions to reducing water content at the opening stage. And for many, this involved grinding clay (and later shale) to a fine powder before pressing and moulding. Called the dry-pressed clay method, the approach was promoted as a way to nearly eliminate drying time, allowing formed bricks to be taken directly to the kiln.

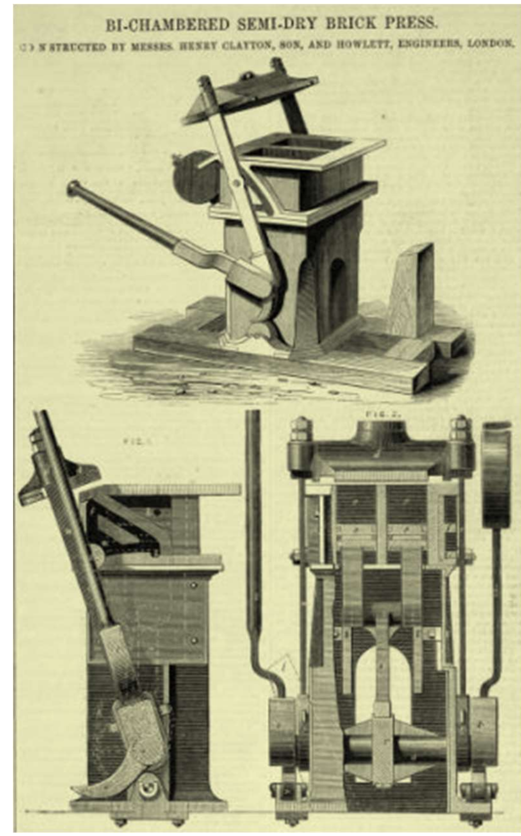
Brick-making Machinery

By the middle of the nineteenth century in England, significant changes to clay availability and the greatly increased demands for brick from burgeoning urban centres, led to significant changes to brick production. As Ms Watt continues in her thesis, *Nineteenth Century Brickmaking Innovations in Britain: Building and Technological Change*: "Manufacturers were forced to establish works at greater distances from urban building sites [and] to use inferior clay deposits which required more time and greater care in their preparation.

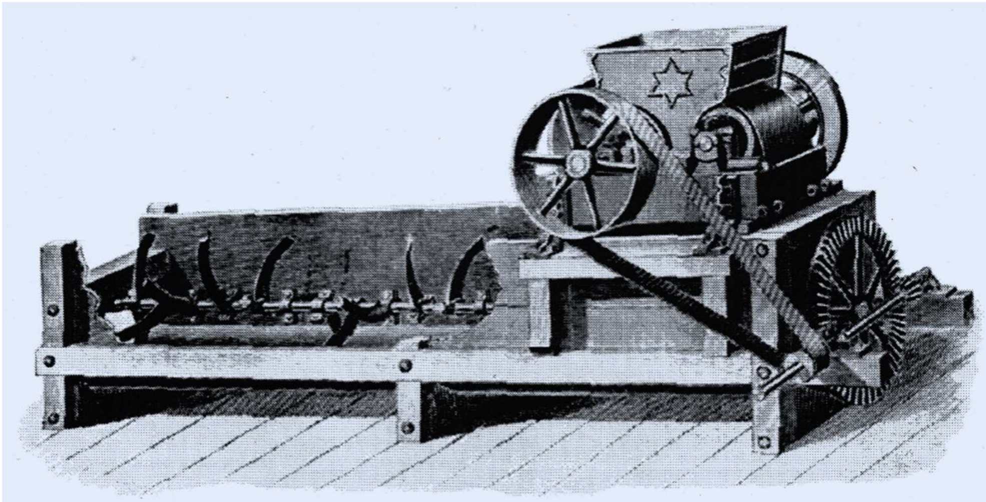
"Pressing machines [were very common, and] were integrated easily into most brickyards. Because they were small and hand-operated by only one attendant, they complemented traditional work practices rather than superseded them. They also were simply constructed, performed only a single mechanical function and worked with partially dried clay bricks rather than with lumps of sticky, wet clay.

"The most prevalent innovations in brick-making … were mechanical devices for moulding the clay. The "Brick and Tile Making Machine" patented in 1741 by William Bailey of Taunton was the first recorded invention in Britain for mechanically forming bricks. Each part of Bailey's machine was analogous to a step in the hand moulding process. Like other early machines, this was a moulding apparatus that essentially imitated the procedures of hand moulding but at a greater speed. Bailey's invention consisted of three parts – a separate mill for tempering the clay in advance of moulding; a brass or iron mould containing five or six bricks that was filled with clay, levelled by a large roller, and afterwards compressed by a stamper or plunger; and a screen to sprinkle soft sand over the empty mould and the roller to prepare them for the repeat motion of the machine."

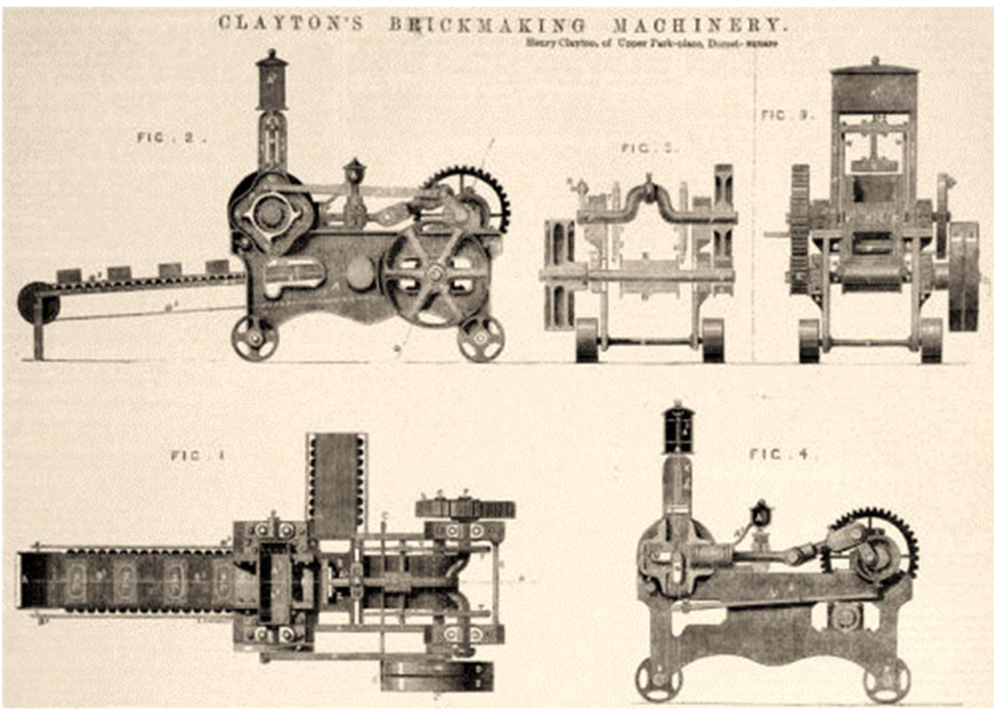
Nearly all subsequent moulding machines were variations, and usually improvements, on Mr. Bailey's invention.

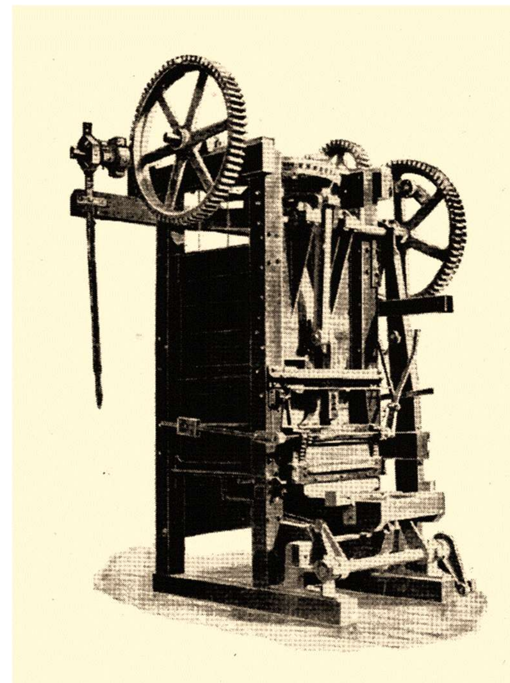


The various technical drawings of a simple bi-chambered semi-dry brick press machine from 1870, designed by Henry Clayton and Howlett Engineers, London. (Courtesy Wiki-Commons)



An array of British and American brick-making machinery from the late 1800s, suggesting the enormous variety of available technology – at top left a dual disintegrator and pug mill from an American firm; below left an 1864 moveable press by Clayton and Co., Atlas Works of Scotland; and below an American soft-mud pressing machine. (Courtesy WikiCommons)

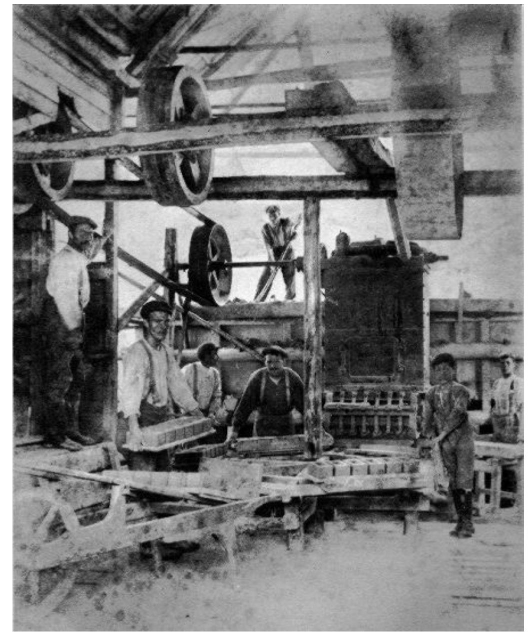




Ms Watt continues: “Inspired by the early success of pressing machines, some inventors experimented with the possibility of combining the processes of moulding and pressing in one operation. By submitting raw clay to a greater amount of pressure in the mould, they hoped to extract unwanted moisture while smoothly finishing and shaping the bricks.”

The inventive energy that was producing apparently numberless new brick-making inventions also turned to completely different processes. As noted in Mr. Stern’s *Cream City: The Brick That Made Milwaukee Famous*, the possibilities of clay extrusion processes, rather than simple brick moulding, were developed by the mid nineteenth century: “Extrusion machinery was based on an entirely different principle for forming bricks and tiles. A column or bar of clay was forced through an appropriately shaped aperture at the mouth of a large container and then cut to the desired size. The form and size of the column was determined simply by the configuration of the die through which the clay was extruded.

“The Chambers Brothers Company of Philadelphia produced one of the earliest successful models for use with stiff-mud clay in 1857. Their machine was an extrusion machine that pushed clay through a die onto a conveyor belt where they were then sanded and cut by knife or later by wire. The machine was initially horse-powered and later driven by steam.”



Workers in the Pittman Brickyard in 1918, in Clarenville Newfoundland. (Courtesy Wiki-Commons)

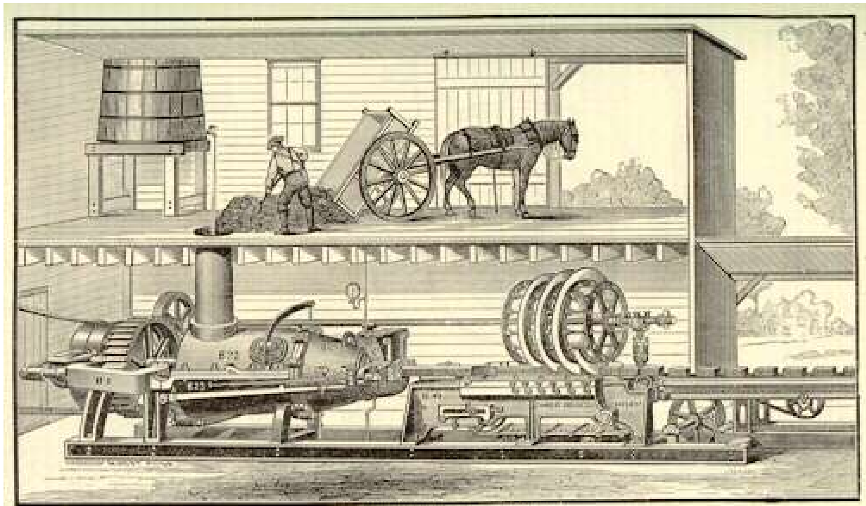
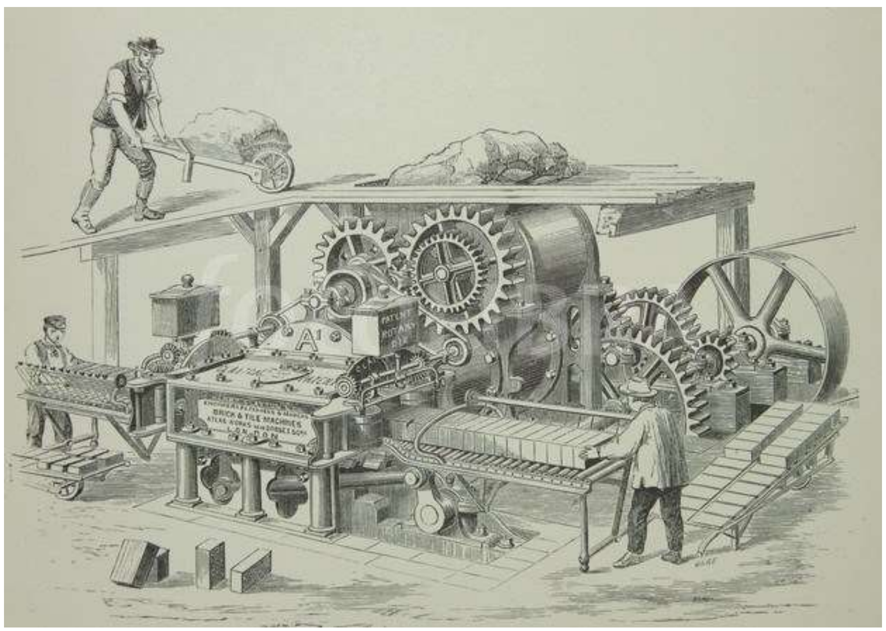


FIG. 2.—The Chamber's brick-machine.

Top: An example of an extrusion brick-making machine, patented in 1863 by Cyrus Chambers of Philadelphia. This impressive piece used stiff mud which was forced out in long ribbons on a conveyor belt, with the clay ribbons then transferred to moulds and cut by a revolving cutter. Up to 25 bricks could be cut at a time. (The Chambers Brick-Machine From: *Appleton's Cyclopedia of Applied Mechanics*, 1892)



Below: The enormously complex brick-making invention of Henry Clayton, of the Atlas Works, London (from 1859) was used by the South Eastern Railway Company, which erected a set of these brick-making machines adjoining their station at Folkestone for the manufacture of bricks for use by the company. An average of 25,000 bricks were produced daily with the attention of two men and four boys. (From: *The Mechanics' Magazine: Journal of Engineering, Agricultural Machinery, Manufactures, and Shipbuilding*, 1859.)

Brick Kilns

The fifth and final step in clay-brick production, firing of the prepared brick, was the subject of great interest and invention in the nineteenth century. By the latter half of the century, it was increasingly clear that the traditional clamp and scove kilns were just too small and inefficient to keep up the with enormous demand for greater productivity and better quality brick. Three new kiln technologies—the beehive, tunnel and the continuous—were the creative responses to these needs. And while the clamp and scove technologies continued to be used at smaller sites, the beehive and tunnel kilns became an increasingly common presence on larger brickyards, while the continuous kiln began to appear only on the largest of brick-factory complexes.

Sketch of a fired brick clamp kiln being unstacked. The whole clamp, the most rudimentary of kiln technologies in the brick-making industry, would have been dismantled after firing, and the bricks sorted for quality – under- or over-fired bricks would have been re-used (usually for the outside walls) when a new clamp was built up for the next firing. (Courtesy Wiki-Commons)

As was noted above, in a recitation of brick-making skills, at least one observer acknowledged "there is more skill wanted in burning bricks than in any other part belonging to [the brick-making process]." And while not mentioned in those observations, we might also assume that there was some additional skill required in placing bricks in the kiln – to ensure the greatest capacity and also the best spacing – a delicate balance that maximized production without jeopardizing quality.

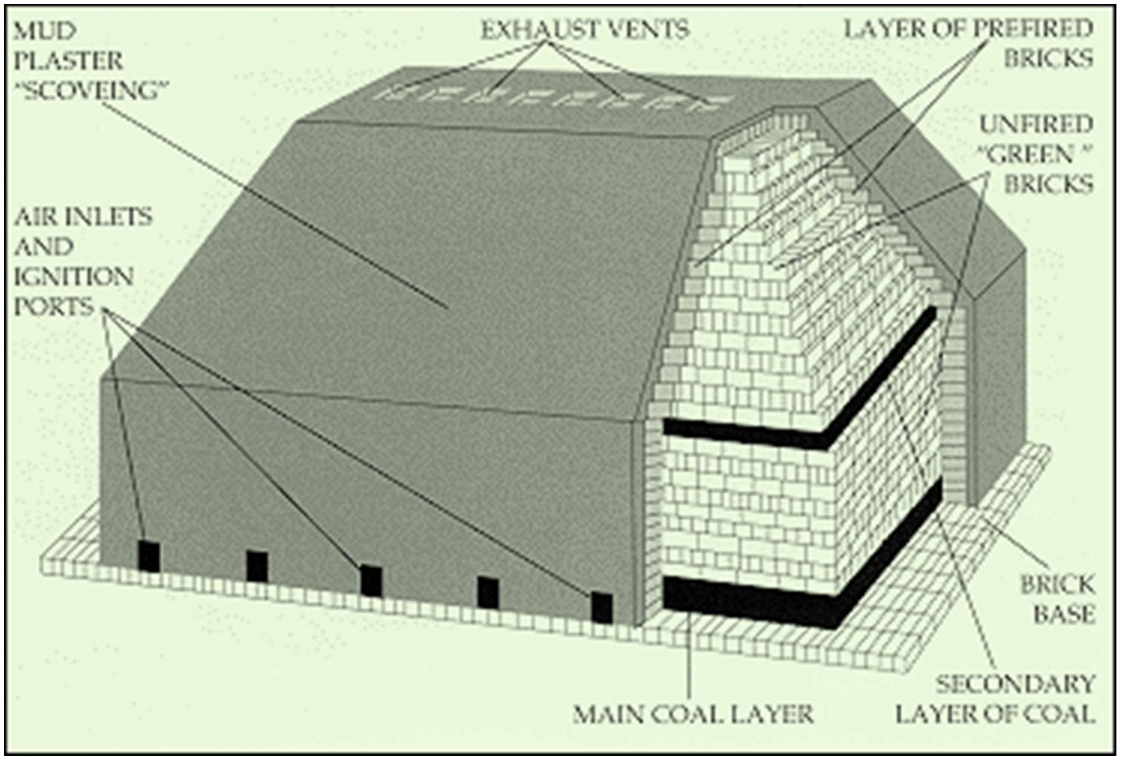
Whether in a clamp, scove, beehive or tunnel kiln, the processes for burning brick were similar; the continuous kiln, discussed later, actually combined many of the traditional processes in one. For all of the kiln types, it is important to note here the chemical transformations caused by firing, and thus of the skill (and occasionally danger) of those involved in this last step – especially of the person charged with this task, increasingly called the brick master.

Bricks that were placed in a kiln were typically dried, up to 14 days in some cases, to ensure more economical use of the kiln, and in fact so that bricks in the kiln did not explode – water content that was too high would often result in catastrophic kiln failures. But even after several weeks of drying, there was still 10-15% water content, and as a kiln was slowly heated, from about 150°C to 600°C, the clay lost its remaining

These two images of late 19th-century brick kilns in England provide comparative views of the two typical kiln types in operation on many small-scale brickyards – at top of a clamp kiln and below of a scove kiln. The basic shape of each type is similar, with a boxy form slightly tapered to the top. The clamp kiln was a temporary structure, essentially a pile of stacked fresh bricks, angled upwards for stability. Firing from sources at the base of the pile would “burn” the bricks, with those within most likely to attain the quality necessary for sale. Outer-layer bricks were typically used when the clamp was rebuilt for the next burn. It is thought that at least a fifth of bricks in a clamp kiln had to be re-fired to meet acceptable standards. The scove kiln was slightly more sophisticated, with the permanent structure loaded with “green” bricks and then fired via small doors at the base. This type of kiln produced much better results compared with the clamp kiln. In both cases several thousands of brick could be burned at a time, over several weeks of operation for a single “burn.” (Courtesy WikiCommons) water content, and a white vapour or steam (called water smoke) would be emitted from the top of the kiln. Once the vapour and gases had cleared, more fuel was added to increase the intensity of heat within the kiln. As the kiln temperature started to rise over 600°C, chemical changes began to occur in the clay. Temperatures of 900°C and above caused vitrification to occur, in which small quantities of glass-like material within the clay began to form, causing all other elements to fuse together. It is after the point of vitrification that the brick would be at its hardest and most resistant, ideal for its purpose as a construction material.

The intense fires in a kiln had to be maintained around the clock for about a week. The knowledge and experience of the brick master dictated when the fire-holes of the kiln would be bricked over to ensure a solid seal, with the heat allowed to slowly dissipate for another week or more. It might take an additional week for the burned bricks to be sufficiently cooled to allow for their removal. For clamp kilns it was at this stage that the entire kiln was dismantled and brick removed and sorted for quality.

The physical property of heat movement in a clamp or scove kiln, in which the heat radiated up from a ground-level source, led to these kilns being defined as up-draught kilns. The beehive, tunnel and continuous kilns were developed on the down-draught approach, in which heat was directed upwards along the outer edges of the kiln, and then forced down, and out, via chimneys a slight distance from the kilns – this process ensured more even burning, and much less wastage compared with clamp and scove kilns. Clamp kilns were notorious for iffy results, and the inability to control the temperature and wind drafts often resulted in wildly variable production: bricks at the centre of a kiln tended to be melted, whereas bricks at the edges were often left unburned.

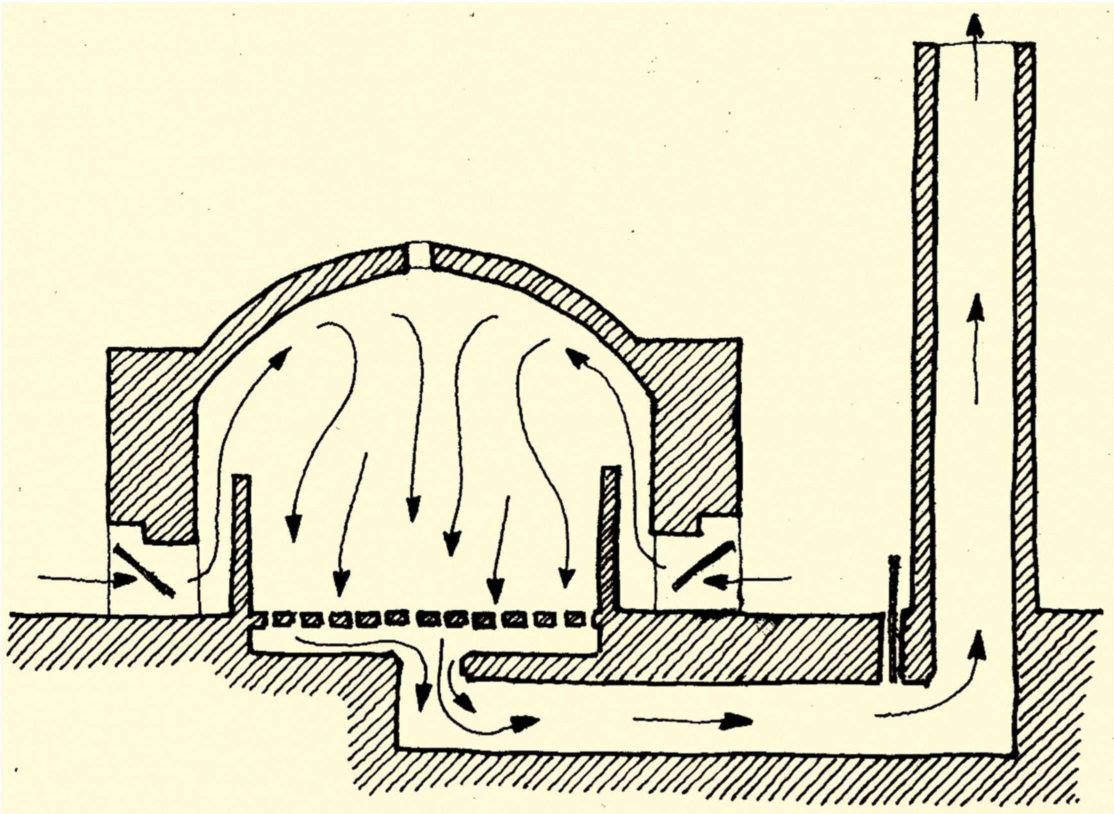


A schematic view of a scove kiln. The "green" bricks were arranged with a series of connecting spaces or flues that allowed the heat to circulate upwards from fires lit at the bottom. The monolithic structure would have small fire-holes at the base to allow for the heat sources, with openings at the top to encourage the up-draught required for effective burning, and also to release steam and gases. Such a kiln could contain as many as 80,000 bricks at full capacity. Raw bricks were arranged in the kiln so as to leave narrow gaps in between each brick to ensure an even burn. (Courtesy Wiki-Commons)

The development of the beehive kiln was a major improvement over the clamp and scove kilns. The distinctive shape of these kilns, as would be expected similar to a beehive, was based on fires being produced outside of the kiln and carried in through flues. The kiln consisted of a single domed chamber in which the unfired bricks were placed, and with curved walls at whose base a number of fire-mouths were located, where wood or coal was burned. Beehive kilns were usually reinforced with exterior steel bands to keep the brickwork from deteriorating through periodic cooling and heating. The kiln's design and physical properties of heat movement ensured that combustion occurred near the top, or crown, of the kiln, and was drawn downwards through holes in the floor, which via suction led to flues connected with an independent chimney. These down-draught kilns often had short chimneys built in connection with the fire-mouths, and several kilns could be joined together in a row or group having their bottom flues connected with the same tall chimney.

A view of multiple beehive kilns and chimneys at the brick factory at Clay City, Washington, 1910. Combining a number of beehive kilns and chimneys was a common way to develop an especially large clay or shale deposit at this period of the North American brick-making industry. (Courtesy WikiCommons)

View of one of the three beehive kilns at Porth Wen in Wales, an operation active at the turn of the 20th century. The typical form and structure of this type of kiln is evident here – with a circular plan and domed roof. Large arched openings provided access for loads of "green" bricks, as well as for fuel (wood or coal) to fire the kiln. Encircling iron straps kept the kiln stable, a common concern with the constant heating and cooling of the brick-making process. The tall chimney in the background was a necessary feature of down-draught kiln technology, required to draw super-heated air from the kiln over the bricks and out to the chimney. (Courtesy WikiCommons)



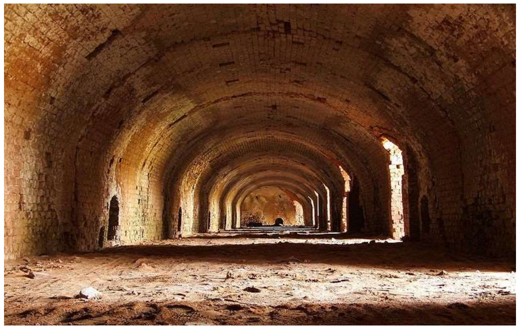
A cross-section view of a typical beehive kiln. The main feature, the kiln, was formed as a dome, which when built of brick provided the greatest level of structural stability. Raw bricks would be stacked within the cavity, getting fairly close to the dome's crown. Heat would be generated at in openings around the perimeter, and then circulated within the kiln via the down-draught process, to distinguish it from the simpler up-draught process of clamp and scove kilns. By placing the flues beneath the flooring and connecting them to a nearby stack, heat would be drawn down through the "green" bricks, making for more efficient and reliable firing, and creating less wastage of poorly fired bricks. Upon completion of firing, the kiln would be cooled for two to three days, at which point the temporary doors would be dismantled and finished bricks would be unloaded to a storage lot. (Courtesy WikiCommons)

An innovation on the down-draught concept saw many kilns built as vaulted brick tunnels. These kilns also had external heat sources, along the kiln's extent, and a slightly removed chimney that drew the heat upwards and over the raw bricks, ensuring a more even burn. Like the beehive kiln, which required encircling iron bands to maintain stability, with the ongoing heating and cooling of the structure, tunnel kilns were invariably built with distinguishing brick or metal buttresses along the outside walls, with connecting beams or iron chains along the top that kept the whole structure stable. In some cases the heating ports were actually devised as small chimneys, providing the necessary heating along its length.

View of a tunnel kiln. (Courtesy Wiki-Commons)

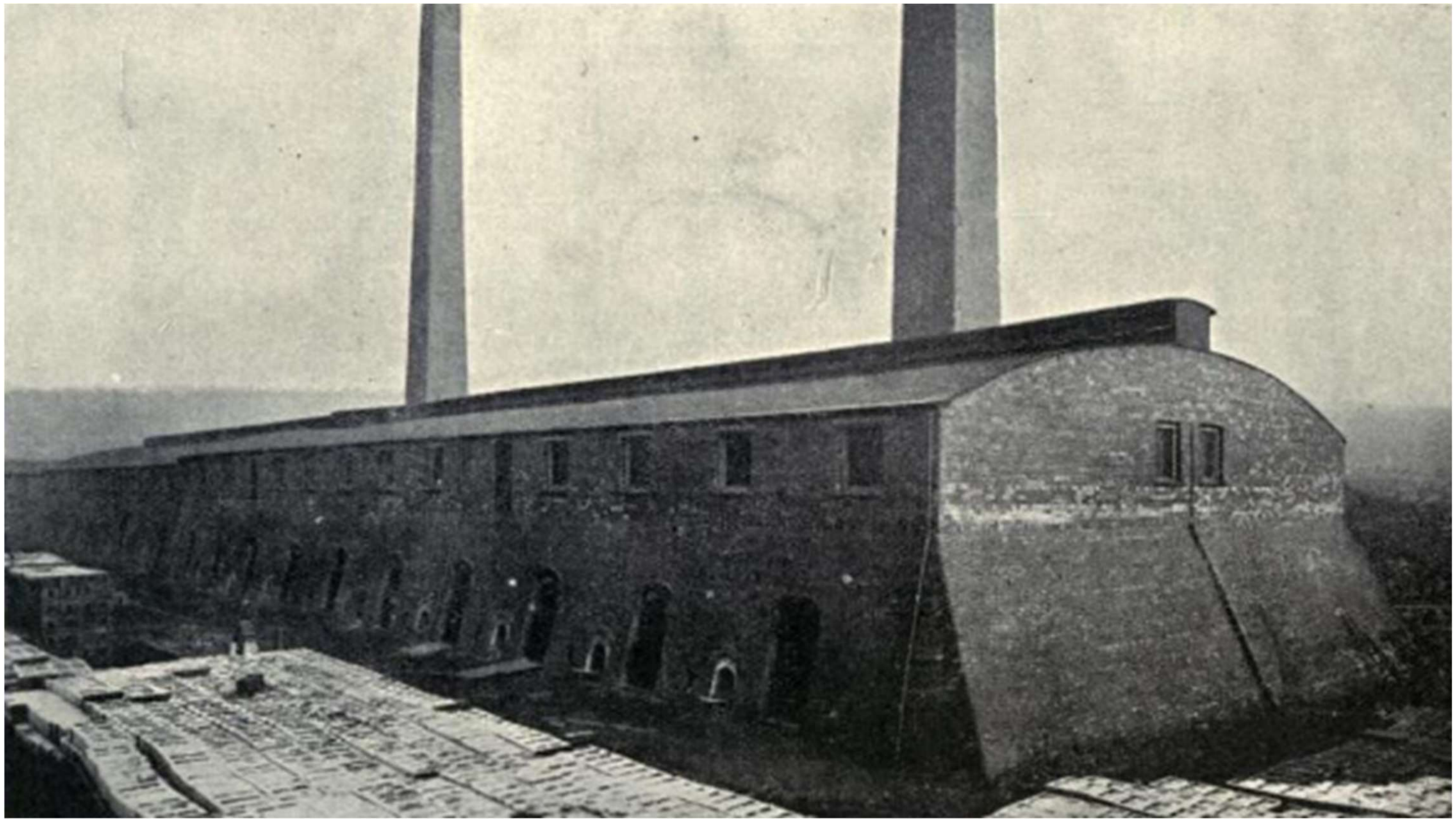
Example of a tunnel kiln at the Ochiltree-Burnfoot Tile Works in Scotland. The distinctive barrel vault and metal support structure are visible here. The large arched door would have been bricked in when a burn was underway. (Courtesy *Scottish Brick History*)

The method of using one tall chimney to work a group of down-draught kilns, and especially the example of the basic tunnel kiln, led to the invention of the continuous kiln, the earliest form of which was developed by Friedrich Hoffman, in 1858. The inventive principle of the continuous kiln was the utilization of the “waste heat” from one section of a kiln in heating up another section, and thus using lesser heat for other purposes, in particular for drying. At the same time, cooler air that was drawn in when bricks were unloaded, travelled in the opposite direction and cooled down the already baked bricks in the preceding rooms. It has been noted that the fire in such a kiln was "chased" around the building in a never-ending process that was extremely energy-efficient. It has also been observed that the principle of the Hoffman kiln anticipated twentieth century mass production, but instead of the product being brought to the process, as happened on a Ford automobile assembly line, the process was brought to the product.



Interior view of a continuous kiln, with partition walls removed. (Courtesy Wiki-Commons)

The original Hoffman kiln was elliptical in plan, but that complex form was more often adapted to a basic rectangular form, with chambers set side by side in two parallel lines. These chambers were connected at the ends by other kilns so as to make a complete circuit. Continuous kilns produced a more evenly fired product than the intermittent kilns, and at a much-reduced cost for fuel. And they were enormous, holding up to 300,000 bricks for a single firing. Depending on the size of the kiln, it could take between one and six weeks for the “fire” to complete a full circle. They were also only ever developed by the largest and most sophisticated brick-making operations, and mostly only in the twentieth century.



Example of a continuous Hoffman kiln, only used at sites with an industrial capacity. The chambers of this kind of kiln were filled with bricks (some 25,000 of them at a time) and fired one after the other. The heat in one chamber was not only used to bake the bricks inside, but also to preheat the still-to-be-fired bricks in succeeding chambers. These kinds of operations might employ 100 people and produce more that 12 million bricks a year. (Courtesy WikiCommons)