

Editorial note

This extract has been prepared as it describes the manufacturing techniques likely to have been used the Bridgwater brickyards in the mid C19, before mechanisation. There is no companion account of tile making

Tomlinson's *Cyclopaedia of Useful Arts* is a multi-volume encyclopedia focusing on manufacturing, mining, and engineering. It was edited by Charles Tomlinson, (1808-1897) a Fellow of the Royal Society, and a lecturer at King's College School, London. The original was published between 1852 and 1854 in two volumes with 40 steel engravings and 2,477 woodcuts. A supplement was published in 1862 by James S. Virtue, London and New York City.

It was devised to celebrate the Great Exhibition and the work is a valuable source of information about the "how" of handicraft, industry and manufacturing, since it contains numerous articles, illustrated by woodcuts, describing the techniques.

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Digitised and edited by Tony & Jane Woolrich, 24/05/2020

BRICK. A building material, known at a very early period of the world's history, formed of tempered clay, hardened either by exposure to the sun's rays, or to the heat of a furnace. Bricks were used in the building of Babel, and it would appear that they were burnt bricks. (*Let us make brick, and burn them thoroughly. And they had brick for stone, and slime had they for mortar.* Gen. xi. 3.) Also in the walls of Babylon, where the clay thrown out of the trench surrounding the city, supplied the material; and especially in the pyramids and other buildings of Egypt, where their manufacture gave employment to a vast number of persons, and at last became important enough to be undertaken by the state. Thus the public purchased of the government, and private individuals were forbidden to engage in the manufacture, or to use any bricks to which the government stamp was not affixed. The brick-makers worked in gangs, under the superintendence of overseers and task-masters; the clay was worked up with chopped straw, and the bricks prepared from it were dried in the sun. The employment was laborious, and the task-masters were as exacting as in later times. (Exod. v. 6 – 19.) The principal pyramids of Egypt are built of stone, but several of the

smaller are of brick, as that of Howara, which is constructed of crude bricks, containing chopped straw. These bricks measure 17½ inches by 8¾ inches, and are 5½ inches thick. In some cases the bricks contain not only straw, but pieces of broken pottery and stone, and are very irregular in size. A brick pyramid about ten leagues from Cairo, is supposed to be that mentioned by Herodotus, as having once borne the following inscription : *Disparage me not, by comparing me with pyramids made of stone : I am as much superior to them as Jove is superior to the rest of the deities : I am constructed of bricks, made from mud, which adhered to the ends of poles, and was drawn up from the bottom of the lake.*

Unburnt bricks were used in the walls of Athens, and in the construction of several Grecian temples and palaces. Vitruvius expressly describes the manner in which these bricks were made, and the proper seasons for drying them regularly; namely, spring and autumn. The inhabitants of Utica made use of such bricks only as were five years old, and had been approved by a magistrate.

The Romans made use of bricks to a far greater extent than the Greeks, as the remains of their public edifices plainly show: some of their brick structures raised 1,700 years ago still remain as entire as when first built. To that people, doubtless, we are indebted for the introduction of the art into Britain. But the use of brick does not appear to have become general in this country until after the Norman conquest, nor to have attained any remarkable degree of perfection until so late as the reign of Henry VIII., when many interesting buildings were constructed of this material, in a style which has made them objects of admiration in our own age. Yet it was only for the more important edifices that brick was solely used ; the ordinary houses consisted of a frame-work of timber, either filled in with lath and plaster, or with bricks introduced in panels. The danger of so great use of timber in a crowded city became evident when the great fire of London desolated the homes of the metropolis, and after that event, it was wisely ordained that brick should be the material of the future city, and that even the ornamental part of the houses should be contrived in the same material. Thus, brick-work came to be carved and made to assume the forms which more properly belong to stone, such as Doric pillars, and rich entablatures curiously wrought with the chisel subsequent to the erection of the walls.

In Holland the art of making very durable bricks was practised at an early period, the floors and pavements being constructed of that material. These remain un-injured for a surprising length of time, and exhibit the superior quality of the brick. English bricks are decidedly inferior to these, not on account of any defect in the materials, but on account of the saving of labour and fuel which is sought after in the majority of cases, and which is rendered necessary by the mania for cheapness. The system prevailing in the metropolis fosters this mania, for the great majority of the lands are let on building leases, and it is to the interest of the builder to erect houses which shall merely last out the lease, since, at the expiration of that period they become the property of the landlord.

The operations connected with ordinary brick-making are briefly these : digging the clay in autumn ; leaving it to mellow by frost during winter, the masses being frequently turned and broken up, to expose them more completely to the action of the atmosphere : throwing the crumbled clay in spring into shallow pits, where it is watered and soaked : then tempering the clay by treading and kneading by the feet either of men or oxen, or by means of a horse-mill : next conveying the kneaded clay to the bench of the moulder, who takes a lump and dashes it into a wooden or iron mould, striking off the superfluous clay with a strike or smooth piece of wood. The bricks are delivered from the mould, and ranged on a barrow or on the ground, until they are firm enough to bear handling, when they are trimmed with a knife. They are then built up in long dwarf walls, with sufficient space for the air to penetrate in every direction : these walls are thatched as a protection from the weather, and thus the bricks are left to dry until they are in a proper state to be consigned to the kiln.

The various argillaceous earths used in brick-making are generally mixed with some other substance, being for the most part unfit to be used alone. Some are almost pure clay or alumina, and are strong, and exceedingly plastic, but cannot be dried without splitting. Others, being light sandy clays or loams, are too loose to be made into bricks without the admixture of lime as a flux, to bind the materials together. Others again are natural compounds of alumina and silica ; but these if free from lime, magnesia, or metallic oxides, are exceedingly valuable clays, being from their infusible nature adapted for

making fire-bricks for lining furnaces, for making crucibles, glass-house pots, &c. Fire-clay is found throughout the coal-measures, and occurs in abundance, and of excellent quality, at Stourbridge, and also in the vicinity of Newcastle and Glasgow.

Bricks for ordinary uses are known as *place-bricks*, *grey and red stocks*, *marl-facing bricks*, and *cutting bricks*. The *place-bricks* and *stocks* are the ordinary wall bricks. The *marls* are very superior bricks, made in the neighbourhood of London, and used on the outside of buildings. The finest kind of *marls* and *red bricks* are called *cutting bricks*, and are used in arches over doors and windows, being rubbed to a centre and gauged to a height. The *red bricks* made of *Hedgerly loam*, from a village of that name, near Windsor, are used as *fire-bricks* about furnaces and ovens. Foreign bricks are *Dutch* and *Flemish* bricks and *clinkers* : they are similar in quality, and of a dirty brimstone colour. The first two are used for paving yards, stables, &c., and the *clinkers* which are most baked are used for ovens. *Place-bricks* are also used in paving dry, or laid in mortar, and they are put down flat or edgewise. If they are laid flat, 32 of them will pave a square yard ; if edgewise, twice that number are required. *Ventilating bricks* are an invention of modern times. They are double the size of common bricks, although they contain only the same quantity of clay. They are hollowed out at the sides, so that when two are placed side by side, a circular opening is left between them, which, when tiers of similar bricks are laid on, forms of course a tube within the wall, and this may be applied to the purpose of either warming or ventilation.

The first process in brick-making is the tempering of the clay, which, as we have said, is the work of early spring, after it has lain exposed to the frost during winter. Great care is then taken as the clay is being turned over and tempered with water, to remove by hand every stone that can be discovered in the plastic mass ; for the presence of even a small pebble in a brick causes it to crack in drying. Of course this hand-picking is impossible where much gravel occurs : in such cases the clay must be washed in a trough filled with water, until it becomes liquid enough to pass off through a grating into pits prepared for its reception; the gravel meanwhile being retained by the grating. In districts where veins of skerry or impure limestone abound, it is found desirable to grind the clay between

rollers, which crush the limestone, and thus obviate the evil which arises when even a small piece of this substance remains in a brick, and by the carbonic acid driven off from it in burning, forces a hole in the brick, and destroys its usefulness.

For the marl, or *malm* bricks, made near London, and used for the best outside work in houses, the clay is dug in autumn, ground to a pulp at once in a wash-mill, and mixed with chalk previously ground to the consistence of cream. This pulp is run off through gratings, and allowed to settle until it is firm enough for a man to walk upon it : it is then covered with finely-sifted ashes, and allowed to remain all the winter to mellow. In the spring the ashes are thoroughly mixed with the clay and pugged in a pug mill. This is a conical wooden tub, having the larger end upwards, with an upright revolving shaft passing through it, armed with a number of knives, which cut and knead the clay, and force it through the mill, which is constantly filled at the top from the barrows of the work-people, while the clay continually issues from a hole in the bottom, where it is cut into convenient pieces and piled up for future use. The pug-mill is extensively used where the demand for bricks is large, and where the brick-earth is favourable in quality; but in many country places, the indispensable labour of kneading the clay is still performed by the treading of men's naked feet, which become by constant practice sensitive to the slightest roughness in the mass, and able to detect the smallest stone or impurity.



Fig. 235. PUG-MILL.

When the clay has been reduced by one of these processes to the necessary state for brick-making, masses of it are successively brought to the moulder's bench. The mould is

without top or bottom, and the workman's art consists in dashing a piece of clay with such force into it, as completely to fill it, and then cleverly striking off the superfluous quantity, and turning out the brick on a pallet, which is placed by a boy on a hack-barrow, which when loaded is wheeled away to the hack-ground, where the bricks are built into long low walls to dry. By another plan, the bricks are shifted at once from the moulder's bench to a drying floor, from thence to the hovel, or drying shed, and from the hovel to the kiln.

The moulder's bench is a rude kind of table, often provided with a trough for water, as well as a heap of sand, the mould being either dipped in water, or sanded, between the making of each brick, that the clay may not adhere. If water is used, the process is commonly called slop-moulding, if sand, pallet-moulding. In the neighbourhood of London, women commonly take part in the operations.

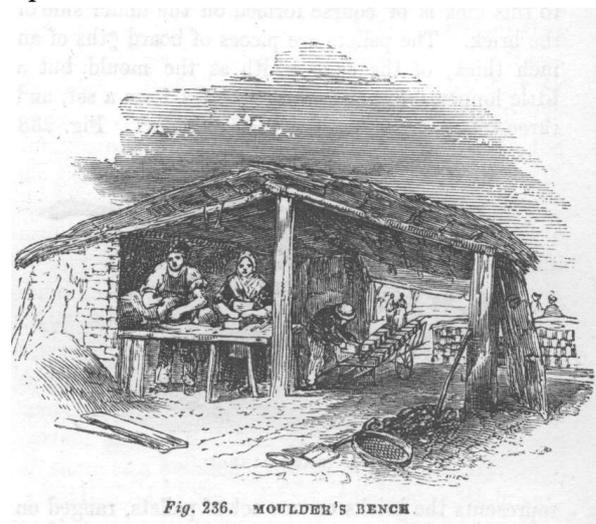


Fig. 236. MOULDER'S BENCH.

The figure represents a woman thus engaged. The moulds were formerly of wood only; they are now sometimes made of brass, cast in four pieces, and riveted together, or of wood lined with brass, sometimes of wood with the edges of iron, sometimes with the two longest sides of iron. Brass moulds do not require wetting or sanding; but they are expensive, and the edges soon become worn. Wooden moulds therefore continue in some districts to be largely used. A good form of mould is a wooden mould lined with brass; the wood as well as the brass being in four pieces, and attached by rivets at the angles. This mould costs about twenty-five shillings, and was formerly still more expensive. The brass overlaps the wood at the edges, where it wears out rapidly, and the cost of repair is nearly as much as the original price of the mould. The figure represents a mould made

of sheet-iron in four pieces, riveted at the angles, and strengthened with wood at the sides.

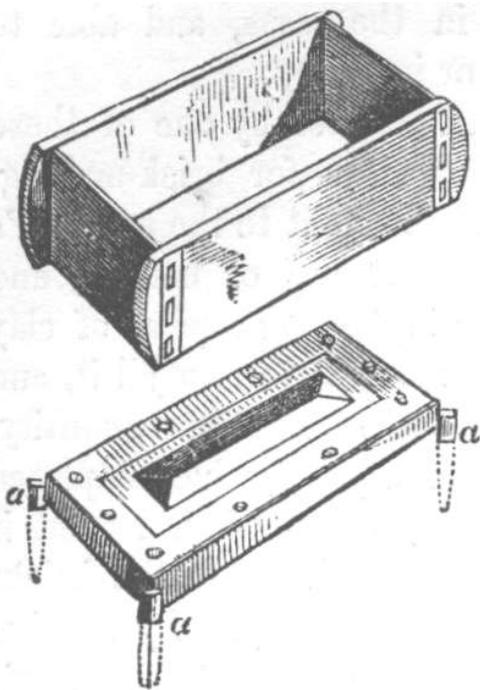


Fig. 237.

The bottom is separate, and is called a stock-board. This is fastened by pins at the corners to the moulder's bench. It is very common at the present time to make bricks with a hollow underneath, both for the sake of lightness, and to leave a bed for the mortar. This is managed by fastening a piece of wood called a kick to the upper side of the stock-board. The mould being placed on the stock-board, (which easily and accurately fits it,) and the clay pressed into the mould, a hollow space corresponding to this kick is of course formed on the under side of the brick. The pallets are pieces of board $\frac{3}{8}$ ths of an inch thick, of the same width as the mould, but a little longer. Six-and-twenty pallets form a set, and three sets are required for each moulder.

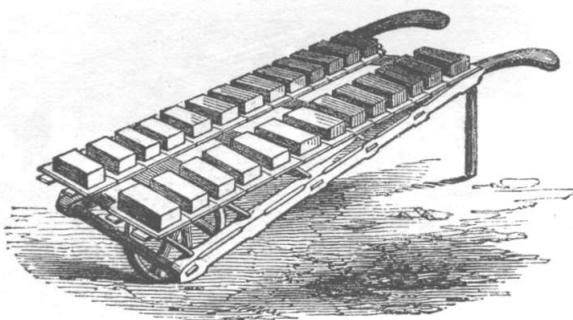


Fig. 238. HACK-BARROW.

The figure represents the bricks on one set of pallets, ranged on the hack-harrow, which has a flat top of light frame work, fit to receive two rows of bricks, thirteen in each row. Three of these barrows are required for use at each moulder's bench, one being constantly loading there, another unloading in the drying ground, and the third being wheeled to and fro. The low walls of bricks in the drying ground are called hacks. These are built two bricks wide, and eight bricks high, and the bricks are generally placed slanting, and not at right angles to the length of the wall. When the bottom row of one hack is formed, the workman begins a second hack, leaving the first to get firm before it has to bear the weight of a second row. Plenty of straw or hay is at hand to cover up the bricks at night, or in bad weather. For the finer descriptions of bricks, drying under cover is adopted, and in some instances flues are carried under the floors of the drying sheds, and currents of air are carefully excluded.

Where the demand for bricks is very large, brick-moulding is performed by machinery. A number of machines have been invented for this purpose, and some of them have answered the end very well. But it is doubtful whether the pressure employed is really an advantage. The density of the bricks is thereby increased, and they are smoother, heavier, and stronger than other bricks, which for some purposes is desirable, but they do not adhere so well to the mortar, they are difficult to dry well, and their weight adds to the expense of carriage, and prevents the workman from laying so many in a given time, as of the hand-made bricks. Machine-made bricks are also frequently disfigured by a ridge caused by the clay rising a little way up the sides of the piston, in the space which, without careful workmanship, is apt to occur between the piston and the mould.

Two brickmaking machines much in favour in this country are Ainslie's ^A and Hunt's. ^B The latter has been extensively used in the execution of large contracts, and consists of two cylinders, each covered with an endless web, which are so placed that they form a sort of hopper on their two upper cylindrical surfaces, the ends being enclosed by two iron plates. The tempered clay is thrown into this hopper, and at the lower part it acquires the form and dimensions of a brick. Beneath is worked an endless chain, by the movement of the cylinders, and at various marked intervals are laid the pallet-boards under the hopper; the clay is brought down

by a slight pressure, and enters a frame, which has a wire stretched across it, which projects through the mass, and cuts off the requisite thickness; this is immediately removed by the forward motion of the endless chain; and this operation is renewed as often as a new pallet-board is advanced under the hopper. Such a machine produces about 1,200 bricks per hour, and is worked by two men and three boys. By this plan less pressure is given than in most machines, consequently the bricks are less difficult to dry equally. Machine-work is cheaper than hand-labour in the moulding of bricks.

Machinery has been recently employed for making bricks and other articles of clay nearly in the state of a dry powder. The clay is subjected to heavy pressure in strong metal moulds, and is by this means reduced to one-third its original thickness. It retains just sufficient moisture to give it cohesion, and the bricks thus formed can be handled at once, and taken direct to the kiln. This method was devised by Mr. Prosser of Birmingham,^c and is highly useful for making ornamental bricks, floor-tiles, &c. By an experiment made on a nine-inch brick of this sort, it was found that the resistance to a crushing force is immense, ninety tons having been sustained without injury.

The final process in brick-making is that of burning the bricks in a kiln or in clamps, the former being the old and the best plan. The kiln may be a simple rectangular chamber, built of old bricks and rubble stone, with a narrow doorway at each end, and narrow fire-holes lined with fire-bricks in the side walls exactly opposite each other. The workmen introduce through the doorways a quantity of bricks, and stack them loosely but with considerable art in cross courses, within the walls, leaving openings that shall act as flues throughout the whole mass, and thus distribute the heat from top to bottom. When the kiln is filled, the top is covered in, and fires are lighted in the fire-holes. The fire is at first got up gently, that the moisture in the bricks may be gradually evaporated; but in two or three days, when the steam ceases to rise, the heat is raised, the doorways are bricked up, and the temperature continued till the fire begins to appear at the top. It is then slackened, and the kiln allowed to cool. The heating and cooling are then repeated, and in about 48 hours the bricks are thoroughly burnt. An ordinary kiln will hold 20,000 bricks. The fuel consists in some places of fagots of furze, heath, brake, &c., in others

of pit coals. When bricks are burnt in a clamp, they afford to a great extent their own fuel, for a clamp is an immense pile of carefully arranged bricks, in which breeze, (the technical name for ashes,) has been mixed with the clay in their manufacture. But layers of breeze are also added, and the whole is set fire to by means of fireplaces and flues filled with wood, coal, and breeze. The burning of a clamp continues from two to six weeks. The art of clamping well exhibits no mean degree of skill in the workman. They first build an upright or double battering wall along the centre, and then arrange a number of other walls in an inclined position on each side, corresponding in length and height with the central wall, and supported by it. The sides and top of the clamp are cased with burnt brick, and the lower courses of the central double wall are of the same material. There are numerous live-holes left in a large clamp, and these are fired in succession. The bricks near these live-holes are burnt too much, and generally spoiled by running together in masses called burrs, and the bricks at the outside of the clamp are not burnt enough, and are laid aside for re-burning in the next clamp. Much judgment is required in apportioning the fuel to the size of the clamp, for the whole may be easily underburned or overturned, and so deteriorated or rendered comparatively useless. The burrs and clinkers, or shapeless masses of fused brick, may often be recognised in the rock-work of suburban gardens, while the pale underbaked bricks, sold at low price, are used in the inferior unsubstantial erections which disgrace the neighbourhood of the metropolis.

The processes above described are not universally prevalent. On the contrary, various differences exist in particular districts. These are well indicated in the following paragraph from Dobson's clever *Treatise on Brick and Tile-making*.¹ *In some districts the clay is ground between rollers, and the pug-mill is never used. In others both rollers and pug-mills are employed. In the neighbourhood of London rollers are unknown, and the clay is passed through a wash-mill. Equal differences exist in the processes of moulding and drying. Lastly, the form of the kiln varies greatly. In many places the common Dutch kiln is the one employed. In Essex and Suffolk the kilns have arched furnaces beneath their floors. In Staffordshire, bricks are fired in circular domed ovens called cupolas.*

At the close of the last century, bricks were for the first time subjected to taxation. A duty of 2s. 6d. per thousand was imposed on all bricks, and this was afterwards raised to 4s. per thousand. Subsequently, bricks were divided into common and dressed, and separate duties were laid upon each. In 1833, the duties on tiles were wholly repealed, but those on bricks still remained, and were raised two years later, so that common bricks paid 5s. 10d. per thousand, and superior ones a higher rate. In 1839, the duty of 5s. 10d. was made general on all bricks, without distinction of shape or quality, and this was felt as a boon, because the restrictions had previously limited the manufacture of various patterns. It was also enacted that bricks used in draining marshy land should be exempt from duty, provided the word *Drain* was legibly stamped upon them. Bricks made in Ireland, and also bricks for exportation, were never subjected to duty, but with respect to the latter, sufficient security was required before shipment that they should not be re-landed in England, and if it was discovered that this was done, the owner had to suffer, over and above the penalty in his bond, the forfeiture of the whole cargo. By a recent act, the duty on bricks was wholly repealed. Notwithstanding the influence of the duty, the number of bricks made in England has nearly doubled during the twenty years ending with 1840, the number that paid duty in 1821 having been 899,178,510, whereas in 1840, it amounted to 1,677,811,134 ; and the latest accounts make it nearly 1,800,000,000, which produced an annual revenue approaching 600,000*l.* The manufacture of bricks in Scotland is much less important than in England, owing to the extensive use of stone as a building material in that country.

Notes

1) Weale's Rudimentary series



Editorial notes

A) John Ainslie, Patents 8965; 8988; 10,481; 11,115 and 13, 376, 1841-1850

B) John Hunt, Patent 13,146 of 1850

C) Richard Prosser of Birmingham (1804-1854) Inventor and patent reformer he held fourteen patents in all. See ODNB.

He wrote chapter 11 "On the manufacture of bricks in the Staffordshire Potteries" in Edward Dobson, *Rudimentary Treatise on the Manufacture of Bricks and Tiles*, Weale, 0000