a gauge-mould or a ranging trammel, for every course, as it must be evident that the line cannot be applied to this in the manner just described. For every wall of more than one brick thick, two men should be employed at the same time, one outside and the other inside; one man cannot do justice from one side even to a 14-inch wall.

Bricks should not be merely *laid;* every brick should be rubbed and pressed down in such a manner as to force the mortar into the pores of the bricks, and so produce absolute adhesion. Moreover, to make brickwork as good and perfect as it may be, every brick should be made damp, or even wet, before it is laid, especially in hot weather, otherwise it immediately absorbs the moisture of the mortar, and, its surface being covered with dry dust, and its pores full of air, no adhesion can take place; but if the brick be damp, and the mortar moist, the dust is enveloped in the cementitious matter of the mortar, which also enters the pores of the brick, so that when the water evaporates their attachment is complete. To wet the bricks before they were carried to the scaffold would, by making them heavier, add materially to the labour of carrying; in dry weather they would, moreover, become dry again before they could be used, and for the bricklayer to wet every brick himself would be an unnecessary waste of his time; boys may therefore be advantageously employed to dip the bricks on the scaffold, and supply them in a damp state to the bricklayer's hand. A watering-pot with a fine rose to it should also be used to moisten the upper surface of the last laid course of bricks preparatory to strewing the mortar over it. In bricklaying with quick-setting cements all this is of even more importance; indeed, unless the bricks to be set with cement are quite wet it will not attach itself to them at all.

Mortar joints and beds.

As mortar is a more yielding material, used in brickwork merely for the purpose of making the detached portions of the staple adhere, by filling up their interstices and excluding the air, and the object is to produce as unyielding and consistent a mass as possible, no more should be used than is sufficient to produce the desired result. No two bricks should be allowed to touch, because of their inaptitude to adhere to each other; and no space between them should be left unoccupied by mortar which may produce adhesion. When the bricks are a fraction under 2½ inches thick, four courses of bricks and mortar, or brickwork, are usually allowed 11 inches in height; and if they are fully that thickness, four courses are allowed 11½ inches. The result of thick beds of mortar between the bricks is, that the mortar is pressed out after the joint is drawn, on the outside, in front; and being made convex instead of slightly concave, the joints catch every drop of rain that may trickle down the face of the wall, and are thus saturated; the moisture freezes, and in thawing bursts the mortar, which crumbles away, and creates the necessity, which is constantly recurring, of pointing the joints to preserve the wall. The diagram, fig. 6, shows the section of a 9-inch wall, with the joints on the side *a* as drawn, and on the side *b* as bulged, in consequence of the quantity of mortar in them yielding to the weight above. This, too, is in addition to the inconvenient settling, which is the consequence of using too much mortar in the beds. In practice, bricklayers lay the mortar on the course last finished, and spread it over the surface with the trowel, considering that it will fill the space between the bricks of that course, in addition to what they may have placed in the edges of the outside joints; but the mortar ought not to be so thin as to fall into the joints by its own weight; so, unless they press it down, half the height of

Fig. 6.

the space between the bricks remains unoccupied, and the wall is consequently hollow, incompact, and necessarily imperfect. To obviate this, it is common to have thick walls grouted in every third or fourth course; that is, mortar made liquid, and called grout, is poured on and spread over the surface of the bricks, that it may run in and fill up the joints completely. This, at the best, is but doing with grout what should be done with mortar; and filling or flushing up every course with mortar requires very little additional exertion, and is far preferable. It also assists in making the house warmer and drier, by preventing the passage of wind or damp through the joints.

All the walls of a building that are to sustain the same floors and the same roof should be carried on simultaneously; under no circumstances should more be done in one part than can be reached from the same scaffold, until all the walls are brought up to the same height, and the ends of the part first built should be racked back, as at *a b*, Plate XX. fig. 2, and not carried up vertically with merely the toothing necessary for the bond, as at *a b*, fig. 3.

Brickwork should never be carried on in frosty weather, nor even when it is likely that frost will occur before the walls can be covered in or become so dry as not to be affected by frost. Covering an unfinished wall with a thick layer of straw when frost may supervene is a very useful precaution; and on the straw weather-boarding should be laid, to prevent access of moisture from rain or snow. Merely wet weather may be guarded against by following the directions given above as to flushing every course of the work well up with mortar, so that no interstices be left into which water may insinuate itself, and by covering the walls with boards to act as a coping when the men are not actually at work on them; the joints in the face of a wall that is not to be plastered in any way should be protected in this manner with great care.

Damp proof course.

After the footings of a wall (above noticed) have been brought up to the level of the finished surface of the ground, or to the underside of the joists of the lowest floor, there should always be introduced a damp-proof course, intended to prevent that rise of damp from the soil in the brickwork which is the cause of so much disfigurement and injury to buildings. This damp course is formed in various ways, as a layer of asphalt, or asphalt canvas, or some similar material. One of the best and most usual, as the materials are always at hand, is formed of two courses of slates, well breaking joint, and set in cement. Another is Taylor's or Jennings's patent stoneware damp course, which being pierced horizontally admits air to the space under the floor and thus ventilates it.

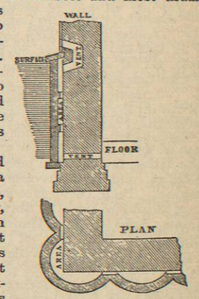


Fig. 7.

Dry areas.

Where the ground would come against the walls of a basement story, it is requisite, in order to keep them dry, either to form an open drain or area, or to make what is called a dry area. This is done by building up against the soil a thin wall of brickwork not less than 8 inches from the main wall, and either straight or curved, and covering it over above the ground with stone or slate, as in fig. 7. Thus any water coming through the thinner wall falls down, and is conveyed away or soaks through the bottom. This thinner wall requires

support from the main one, and the cavity has to be ventilated

Besides the outer or main walls of a house, there are interior walls, or partitions as they are called. These in large structures are always executed in brickwork; in smaller ones they are usually constructed of timber; and these timbers are often filled in between the uprights by brickwork formed of bricks laid flat or on edge according to the thickness of it. A plate of wood is occasionally introduced to strengthen the work, which is then plastered over This is called a brick-nog partition. In many of the model lodging-houses in London the partition walls have been constructed a half brick in thickness in good mortar, for the whole height of the building, the floor joists being fixed against them to steady them.

Hollow walls.

Another sort of wall consists of two skins of brickwork with a few inches between them; this is called a hollow wall. The two skins, either both of half a brick thick, or the outer one of one brick and the inner one of half a brick, are tied together by iron band-ties at various intervals. These when straight are sometimes found to transmit the wet blown through the outer facing to the inner one, so a bend or loop is formed in the centre of the tie, which throws off the water. This hollow space tends to make the houses both dry and warm, but it is said to form receptacles for insects, &c. An addition to such walls has been lately made by a series of these looped ties supporting a course of slates placed not quite vertical but sloping back slightly. The next course of ties is built in at such a level that it fixes the top of this first course of slate in place, and provides a starting for the next course. Thus, in the heart of the wall there is a continuous surface of slates, slightly overlapping at joists and at beds, and so placed that whatever moisture blows through the outer skin is not able to penetrate, but will trickle down the slates to the bottom of the cavity in the hollow wall. This is one of the many building patents of Mr John Taylor.

Materials and labour for rod of brickwork.

A rod of brickwork will consume about 4500 bricks, though the number will be a few more or less than this, as the bricks happen to be below or above the average size, and as the joints are made thicker or thinner. The quantity of mortar, it is evident, will be affected by the latter consideration also; but in London it is generally reckoned at from ninety to a hundred striked bushels to the rod, or from four to four and a half cart-loads, each containing about one cubic yard. The labour on a rod of brickwork may be done on an average by a labourer in four days; this, however, does not include making and turning the mortar, nor scaffolding. Many things will, however, affect the time in which the work may be performed, both of the bricklayer and his labourer; the former can do one-fourth as much more, at the least, in walls which are to be plastered, as in those in which he has to keep the perpends and draw the joints, &c., and more in thick walls than in thin ones; and the capability of the latter will depend, inversely, on the rate at which the former can proceed, on the distance he may have to carry the bricks and mortar to the foot of the ladder, and mainly on the height he has to carry the materials up the ladder. In great heights, however, the materials should be hoisted.

Tiling being much less in vogue than formerly, in consequence of the better appreciation of the superior qualities of slate for covering roofs, and the moderate cost at which slates are now furnished to the builder, it no longer maintains its separate artificer, but is performed, when it is required, by the bricklayer. Tiling is for the most part of two sorts—plain tiling and pantiling. Plain tiles are simple parallelograms, generally about 10½ inches in length, 6 inches wide, and ⅝ of an inch thick; and each tile has a hole pierced through it near one end, to receive the oak pin by which it is hooked to the lath. The tiles are laid in mortar and sometimes in hay, or moss, on the laths, which in England are of oak or fir, with an overlap of 6, 7, or 8 inches. The greatest overlap or smallest gauge makes the securest work, though it does not present so good an appearance externally as a longer gauge does; and it requires, moreover, a greater number of tiles and laths, thereby adding materially both to the weight and the cost. The great overlap and the mortar (or hay or moss) are both necessary to prevent the rain and snow from driving in between and under the tiles, especially when of a low pitch. Plain tiling requires the pitch of the roof to be at an angle of at least 50°, and is one of the heaviest coverings that can be used, though it is at the same time one of the warmest. The tiles, however, readily and rapidly absorb moisture, which they communicate to the laths and rafters under them, to the serious injury of both the latter; and the mortar in which they are set requires to be frequently pointed, the constant atmospheric changes to which it is exposed occasioning it to crumble and fall away in no long time. Other descriptions of tiling.

Terro-metallic tiles are made with projections at the back to catch on the laths, in lieu of pegs. Italian tiles have been made in England since about 1840, and are occasionally used. They are slightly curved, fit easily one into another, and have a horizontal indentation across the upper part to prevent the wind drifting the rain over the head of the tile. They have either wide or narrow vertical rolls. Taylor's new roofing tiles have a plane surface with slightly turned up edges at the sides, and a lump on the surface near the upper edge to prevent the upper tile slipping. The cover tile is of a similar size and form. They are recommended as half the weight of the common tiling; they are about as light as slating, and may be laid to nearly as flat a pitch.

Pantiles.

Pantiles are parallelograms of irregular surface, straight in the direction of their length, which is 13½ inches, but twisted in the transverse section. Measuring the whole surface across, a tile is 9 inches wide, but in a right line from point to point not more than 7, and its thickness is half an inch; a small tongue or lip is bent down at one end from its flatter convexity, on the under side, to hook it to the lath by, instead of a wooden pin through it, as in a plain tile. Pantiles are set dry or in mortar, on laths. They are not laid side by side, but overlap laterally as in fig. 8; consequently all the overlap they have longitudinally is 3 or 4 inches only, or enough to prevent rain and snow from driving up under the upper, over the end of the lower tile; and hence pantiling is but little more than half the weight of plain tiling. It is, however, a much less warm covering for houses, and is more liable to be injured by violent gales or gusts of wind than the latter is; but again, it presents a far more pleasing appearance to the eye. Pantiling will not bear a much flatter pitch than the other. It is greatly improved by being pointed on the inside with lime and hair. Sometimes, indeed, the whole of the work is, as we have said, set in mortar; but this mode has disadvantages to which pointing internally is not liable, and its superiority in other respects is questionable. In both pan and plain tiling large concave tiles are used to cover the hips and ridges of a roof. These are not generally made to overlap each other in any situation, but are set in mortar, and fastened with nails and hooks fitted for the purpose, and driven into the woodwork of the roof. In addition to these an ornamental ridging or cresting is often introduced. A variety of patterns are now made for this purpose. Another form of

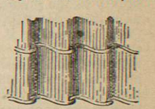


Fig. 8.—Pantiling.

pantile very useful for common purposes is the Bridgewater tile; it is rather wider than the common tile and has a double roll, being about 16½ inches wide and 14 inches long.

As plain tiling is heavier than slating, the plates and rafters of the roofs have to be made stouter than is necessary for slates, consequently the expense of the roofing is added to, supposing that the same thickness of wall be sufficient. The tile also imbibes one-seventh part of its weight or about 5 oz. of water in ten minutes, and takes many days to dry again thoroughly, this necessarily tending to deteriorate the timbers.

When the top of a brick wall is not protected by a roof, it must be covered or coped in some manner, or it will soon be destroyed by the weather. Sometimes this is done by means of a course of bricks set across it on their edges in cement, and called a barge course, but it is a very imperfect covering, for water will trickle down the face of the wall on both sides, as the coping brick can be no longer than the thinnest wall is in thickness. Two double courses of plain tiles may be put side by side under the barge course, making a projection over each face of about 1½ inch, as shown in fig. 9. This is much better than the barge

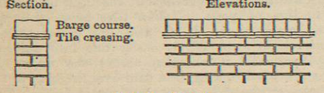


Fig. 9.—Coping.

course alone; but still the covering receives no inclination outwards to throw the water off; the upper surfaces are all horizontal. The same objection exists to foot-paving tiles, which are also used as a coping; but none of these methods is available for any wall above 9 inches in thickness. Stone coping, therefore, which may be made of sufficient width, and be both weathered and throated, is much to be preferred. One of the greatest faults in the modern practice of building, both architecturally as a matter of taste, and practically as a matter of prudence, is, that these copings, and cornices which serve as such, do not project sufficiently to protect the wall from the weather. A massive and well-projected cornice on a wall serves as a roof or pent-house to it; and, besides imparting great beauty to the plainest structure, protects the wall from the premature decay of its upper part especially, and of the joints generally, if it be unplastered brickwork, which thereby calls for the frequent repetition of pointing. Effective and pleasing cornices and blocking-courses may be formed with uncut bricks alone; and these, set in cement, would, with judicious management, add materially both to the appearance and durability of brickwork, without the foreign aid of either the plasterer or the mason. Figs. 10 and 11 show two of the approved modes of forming plain copings in brickwork to garden and other walls.

Brick cornices.

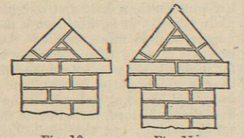


Fig. 10. Fig. 11.

Brick Copings.

From the injury which accrues to the joints of brickwork through bad management in its execution and imperfect protection when executed, arises the necessity, so frequent at the present day, of pointing. Sometimes frost will have supervened before the surfaces of the joints in a wall are dry; consequently, the mortar bursts and peels away, and the whole then requires to be pointed. Preparatory to this operation the scaffold, if it has been struck, must be re-erected, the mortar raked out of the joints to a depth of about $\frac{3}{8}$ of an inch, or deeper if the injury have reached further;—this can be done by a labourer;—a bricklayer then goes over the whole with a hard hair brush and water to cleanse and moisten the joints; and then, with mortar prepared for the purpose, he carefully fills them all up, and neatly draws them with his trowel. This mortar must be of the best quality; it is generally compounded with a certain proportion of forge or smith's ashes, which gives it a blue tinge, and adds greatly to its power of resisting the action of the weather. Cement is sometimes used instead of this blue mortar. If peculiar neatness be required, every joint is marked with a narrow parallel ridge of a fine white putty, in the composition of which bone-lime forms a principal ingredient. The former is called flat-joint, and the latter tuck-pointing. If it be an old wall that requires pointing, a scaffold must be erected before it; and where the putlocks cannot be rested on window-sills and the like, half bricks are generally drawn from the wall to make rests for them, and restored again when the work is done. The former process is then gone through with a common wall; but if it require tuck-pointing, the whole surface is well washed, and then coloured to look like new brickwork, before the pointing is done. The gauged arches over the windows and doors are always coloured, and the joints drawn with peculiar neatness. If in the original building of the wall the perpends have not been preserved, that is, if the vertical joints have not been made to fall perpendicularly in the alternately recurring courses, the workman in pointing stops up the old joints, which are irregular, with putty of a brick colour, and forms false new ones in the proper places.

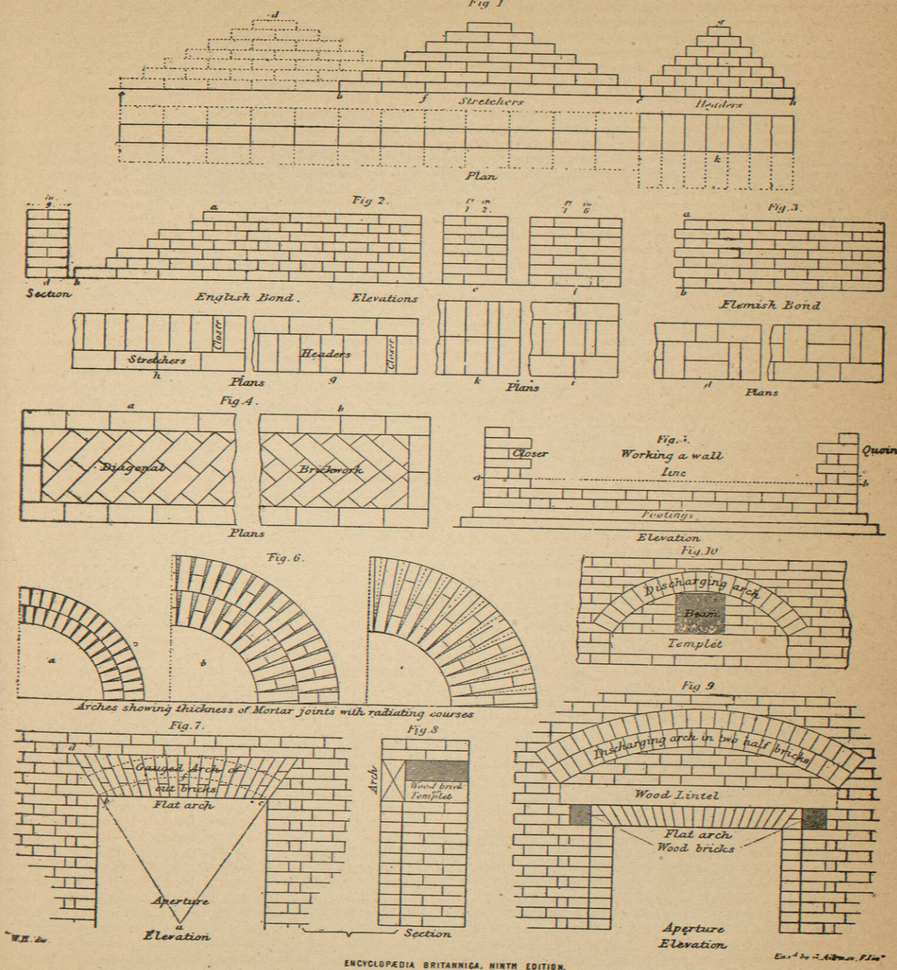
Arches in brickwork are plain, rough-cut, or gauged. Plain arches are built of uncut bricks, and the bricks being parallelopipeds, an arch built of them must be made out with mortar; that is, the difference between the outer and inner periphery of the arch requiring the parts of which an arch is made up to be wedge-formed, as in fig. 12. Arched Plain.

Fig. 12. Fig. 13.

which the brick is not, the difference must be made in mortar, as in fig. 13, so that the inner or lower angles of bricks used for this purpose should all but touch. The mortar should be more consistent than that used in ordinary walling; and the centre on which an arch of this kind is set or built should not be struck or removed until the work is thoroughly hard, or rather all such arches should be set in cement which will harden immediately. In consequence of this inherent defect in uncut-brick arches, in extensive continuous works, such as sewers, tunnels, vaults, &c., it is advisable to make them in thin independent rings of half-brick or one-brick thick, as the case may be; that is, a 9-inch arch should be in two half-brick arches, as at *a*, fig. 6, Plate XX., and an 18-inch arch in two one-bricks, as at *b*, each arch in the latter case being bonded in itself as in a common 9-inch wall with headers and stretchers. It is evident that, by this mode of structure, a greater quantity of the solid material comes into the back or outer ring or arch than into the lower one; and if they had been bonded together into one arch, as at *c*, all that difference must have been made up with mortar. Moreover, whatever pressure comes on the outer ring is carried by it directly to the inner or lower, from whose joints, however, the mortar cannot escape or be pressed out, the inner angles of the bricks, by meeting, preventing it below, and the bricks of the upper arch, which conveys the

VOL. IV. BUILDING. PLATE XX.

BRICK WORK



ENCYCLOPÆDIA BRITANNICA, NINTH EDITION.