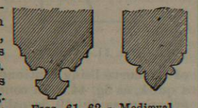
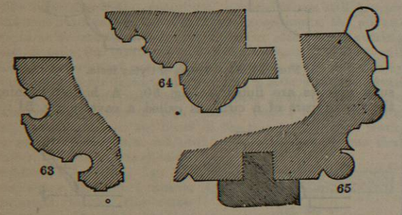
56, which may be made of greater or less projection. Grecian mouldings are all similar in principle, but the parts are of conic sections instead of circles, as explained above, p. 473.

A plain square sinking on the edge of a board, as fig. 57, for the purposes of framing, is called a rebate; if away from the edge, as fig. 58, a groove; placed under a cap (as fig. 59), or as a necking (as fig. 60), it is called a fillet; three such fillets under an ovolo, when composing part of the capital of a column, are called annulets. In all kinds of framing the mouldings which rise above the styles are called bolection mouldings (see fig. 82).

The mouldings during the mediæval period used by the carpenter and joiner, who were perhaps the same person, seldom varied from those cut by the mason, except that they were somewhat more refined and less in size, as appropriate to the material out of which they were to be cut. "They are such as would not be executed in any other material; they are sharp, delicate, minute, and quaintly under-cut. Every curve is subtle; every alternation of round and flat and hollow thoughtfully contrived, graceful, and yet vigorous; they are very often unlike any stone mouldings," says Mr G. E. Street, in a lecture in 1865 on "English Woodwork in the 13th and 14th Centuries," printed in the *Transactions of the Royal Institute of British Architects*. "In the stalls at Selby there is an elaborate cap only 1¾ inches in height; and at Winchester a band ⅛ths of an inch in height, and yet consisting of four distinct members, and showing in elevation as many as eight distinct lines." The woodcuts appended will suffice to explain the author's meaning. Fig. 61 is a mullion from stalls at Winchester Cathedral, and fig. 62 from St Mary's Hospital at Chichester. Figs. 63 and 64 are arch mouldings from the same stalls; and fig. 65, the cornice of a screen in Old Shoreham church. Fig. 66 is a cap and base from the stalls at Winchester.



Figs. 61, 62.—Mediæval Mullions.



Figs. 63, 64, 65.—Mediæval Mouldings and Cornice.

When an inclined or raking moulding is intended to join with a level moulding, at either an exterior or an interior angle, the form of the level moulding being given, it is necessary that the form of the inclined moulding should be determined, so that the corresponding parts of the surfaces of the two mouldings should meet in the same plane, this plane being the plane of the mitre. This may be otherwise expressed by saying that the mouldings should mitre truly together.

When the length of a joint at an angle is not considerable, it is sufficient to cut the joint in such a manner that when the parts are joined, the plane of the joint shall bisect the angle. This kind of joint is shown for two different angles, by fig. 67, and is called a mitre. When an angle of considerable length is to be joined, and the kind of work does not require that the joining should be concealed, fig. 68 is often employed; the small bead renders the appearance of the joint less objectionable, because any irregularities from shrinkage are not seen in the shade of the quirk of the bead. A bead upon an angle, where the nature of the work does not determine it to be an arris, is attended with many advantages; it is less liable to be injured, and admits of a secure joint without the appearance of one. Fig. 69 shows a joint of this description, which should always be used in passages. Fig. 70 represents a very good joint for an exterior angle, whether it be a long or a short one. Such a joint may be nailed both ways. But the joint represented by fig. 71 is superior to it; the parts, being drawn together by the form of the joint itself, can be fitted with more accuracy, and joined with certainty. The angles of pilasters are often joined by this last method. Interior angles are commonly joined as shown in fig. 72. If the upper or lower edge be visible, the joint is mitred, as in fig. 67, at the edge only, the other part of the joint being rebated, as in fig. 70. In this manner are put together the skirting and dado

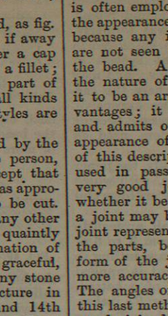


Fig. 66.—Cap and Base from Mediæval Stalls.

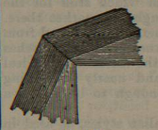


Fig. 67.

Fig. 68.

Fig. 69.

Fig. 70.

Fig. 71.

Fig. 72.

Figs. 67–72.—Different forms of Joints

at the interior angles of rooms, the backs and backlinings of windows, the jambs of door-ways, and various other

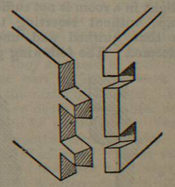


Fig. 73.—Dovetail.

Fig. 74.—Mitre-dovetail.

Fig. 75.—Lap-dovetail.

parts of joiners' work. Fig. 73 is an excellent method of joining angles for drawers, frames for lead cisterns, boxes,

&c., and is commonly called a dovetail. If a portion of the junction is cut off at an angle of 45°, as fig. 74, while the portion at *b* is dovetailed, it is called a *mitre dovetail*; while if the portion at *a* (in fig. 75) passes the other portion at right angles, it is called a *lap-dovetail*. A very good joint is shown in fig. 76, the angles being brought together at an angle of 45°, two or more saw curfs are cut with a dovetail saw, and thin pieces of wood glued in as shown; this is called a *keyed mitre*.

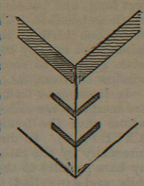


Fig. 76.—Keyed Mitre.

Fig. 77 shows four methods for securing planks together as practised in France during the mediæval period, from Viollet le Duc's *Dictionnaire*. He does not appear to show the junction formed by running a tongue of one piece through another piece and pinning it on the outside, as practised now in England in furniture, as tables, &c.

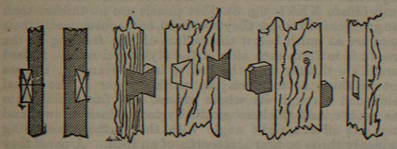


Fig. 77.—Mediæval Joints.

Glue is a viscid tenacious matter used as a cement to connect objects together. The common or animal glue is made from certain portions of animals reduced after certain processes by boiling to the required consistency, and dried in cakes. The best marine glue is composed of caoutchouc dissolved in naphtha, to which shellac is added, and heated until amalgamated. It is insoluble in water, sufficiently solid to give strength, and adhesive to an intense degree. Glue is used principally in putting framed work together, but not at all in fixing; and even for the former purpose it is much less used by good workmen than by bungling hands. When the stuff is well seasoned, and the trying up, setting out, mortising, and tenoning are well and accurately executed, there is no necessity for glue on the tenons and shoulders; the wedges alone need be glued, to attach them to the sides of the tenons, that their effect may not depend on mere compression. Joiners are generally furnished with a cramp, with which to force the joints of framing into close contact; it is either of wood acting by means of wedges, or of iron with a screw. This, too, is unnecessary with good work, every joint of which may be brought perfectly close without great violence of any kind. The cramp will sometimes give bad work the semblance of good, but it cannot make it really so. If any cracking and starting be heard in the joiner's work of a new building, it generally indicates one of two things: either the cramp has been required in putting the framing together, or, having been put together, it has been forced out of winding in fixing, and the constrained fibres are seeking to regain their natural position. A good workman does not require cramp, nor will his work, if he has been supplied with seasoned stuff, ever require to be strained; and consequently the cracking and starting of joiners' work indicate unfit stuff or bad work, or perhaps both. It is true that glued joints will sometimes fly; but when they do, there need be no hesitation in determining the presence of both bad work and stuff in an improper state.

It is seldom possible to procure boards sufficiently wide for panels without a joint, on account of heart shakes, which open in drying. In cutting out panels, for good work, shaken wood should be carefully avoided. That part near the pith is generally the most defective. If the panels be thick enough to admit of a cross or feather tongue in the joint, one should always be inserted, for then, if the joint should fail, the surfaces will be kept even, and it will prevent light passing through. A very good way also is to glue a piece of strong canvas on the back of the panel when the work is not intended to be seen on both sides. Sometimes plane surfaces of considerable width and length are introduced in joiners' work, as in dado, window backs, &c.; such surfaces are commonly formed of inch or inch and quarter boards joined with glue, and a cross or feather tongue ploughed into each joint. When the boards are glued together, and have become dry, tapering pieces of wood, called keys, are grooved in across the back with a dovetailed groove. These keys preserve the surface straight, and also allow it to shrink and expand with the changes of the weather. It would be an endless task to describe all the methods that have been employed to glue up bodies of such varied forms as occur in joinery; for every joiner forms methods of his own, and merely from his being most familiar with his own process, he will perform his work, according to it, in a better manner than by another, which to an unprejudiced mind has manifestly the advantage over it. The end and aim of the joiner, in all these operations, is to avoid the peculiar imperfections and disadvantages of his materials, and to do this with least expense of labour or material. The straightness of the fibres of wood renders it unfit for curved surfaces, at least when the curvature is considerable. Hence, short pieces are glued together as nearly in the form desired as can be, and the apparent surface is covered with a thin veneer; or the work is glued up in pieces that are thin enough to bend to the required form. Sometimes a thin piece of wood is bent to the required form upon a cylinder or saddle, and blocks are jointed and glued upon the back; when the whole is completely dry it will preserve the form that had been given to it by the cylinder. The curve should be made a little "quicker" than the curve intended, as the stuff will always spring back a trifle on being released. A piece of work glued up in thicknesses should be very well done; but it too often happens that the joints are visible, irregular, and in some places open; therefore other methods have been tried.

Large pieces of timber should never be used in joinery, because they cannot be procured sufficiently dry to prevent them splitting with the heat of a warm room. Therefore, the external part of columns, pilasters, and works of a like kind, should be formed of thin pieces of dry wood; and, if support be required, a post, or an iron pillar, may be placed within the exterior column. Thus, to form columns of wood, so that they shall not be liable to split, narrow pieces of wood are used, not exceeding 5 inches in width. These are jointed like the staves of a cask, and glued together, with short blocks glued along at each joint. Fig. 78 is a plan of the lower end of a column glued up in staves; the bevel at A is used for forming the staves, that at B is used for adjusting them when they are glued together. A similar plan must be made for the upper end of the column, which will give the width of the upper end of the staves. The bevels taken from the plan, as at A and B

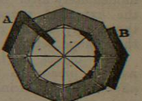


Fig. 78.—Jointing of Column.

are not the true bevels; but they are those generally used, and are very nearly true when the columns are not much diminished. The same method may be adopted for forming large pillars for tables, &c. If a column have flutes, with fillets the joints should be in the fillets, in order to make the column as strong as possible; also, if a column be intended to have a swell in the middle, proper thickness of wood should be allowed for it. When columns are small they may be made of dry wood, and turned in a lathe, when they can be moulded at the same time. Balusters for stairs are made thus. To secure small columns against splitting, a hole should be bored down the axis of each column

If a piece of wood be boiled in water for a certain time, and then taken out and immediately bent into any particular form, and it be retained in that form till it be dry, a permanent change takes place in the mechanical relations of its parts; so that though, when relieved, it will spring back a little, yet it will not return to its natural form. The same effect may be produced by steaming wood; but though both these methods have been long practised to a considerable extent in the art of ship-building, we are not aware that any general principles have been discovered either by experiment or otherwise, that will enable us to apply them in joinery, where so much precision is required. They do not seem to have been tried; and before they can be rendered extensively useful, the relation between the curvature to which the wood is bent, and that which it assumes when relieved, should be determined, and also the degree of curvature which may be given to a piece of a given thickness. The time that a piece of wood should be boiled or steamed, in order that it may be in the best state for bending, should be made the subject of experiments; and this being determined, the relation between the time and the bulk of the piece should be ascertained. A novel and very simple and effective way of boiling sash-bars or thin articles has been adopted,

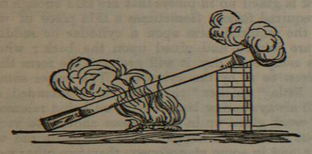


Fig. 79.—Boiling Sash-bars.

as shown in fig. 79. Take a piece of common cast-iron pipe of sufficient diameter, stop up one end with a plug of wood driven tight, fill the pipe with water, raise one end in a sloping position, leaning it on a pile of bricks, and kindle a fire under the pipe. For the joiner's purposes the process might perhaps be greatly improved by saturating the convex side of each piece with a strong solution of glue immediately after bending it. By filling, in this manner, the extended pores, and allowing the glue to harden thoroughly before relieving the pieces, they would retain their shape better.

The object in framing is, to reduce the wood into narrow pieces so that the work may not be sensibly affected by its shrinkage; and, at the same time, it enables us to vary the surface without much labour. Besides this, as the strains from the grain of the wood are in different directions, the work is prevented from winding on its face. From this view of the subject, the joiner will readily perceive that neither the parts of the frame nor the panels should be wide. And as the frame should be composed of narrow pieces, it follows that the panels should not be very long, otherwise the frame will want strength. The panels of framing should not be more than 15 inches wide and 4 feet long, and panels so large as this should be avoided as much as possible. The width of the framing is commonly about one-third of the width of the panel. Frames in joinery are usually connected by mortise and tenon joints, with grooves to receive the panels. Wainscoting, doors, window-shutters, &c., are framed in this manner.

In framing or framed work, the outer vertical bars which are mortised are called styles; and the transverse, those on whose ends the tenons are formed are called rails (Plate XXVI. fig. 2). In doors the open spaces or squares formed internally by the rails and styles are divided in the width by bars parallel to the styles. These are tenoned into the rails, and are called munnions or mountings, or, vulgarly, *muntins*. The frame being formed by trying up, setting up, mortising, and tenoning, the inner or face edges of the styles, and of the highest and lowest rails, and both edges of the muntins and of the inner rails, are grooved with the plough to receive the edges and ends of the filling-in parts or panels of the framework. Panels are either flat, raised, or flush (Plate XXVI. fig. 3). Flat panels are no thicker than the grooves into which they are fitted, and consequently their faces are as much below the surface of the framing as the groove is in from each side of the styles and rails. Raised panels are thicker than the groove in the framing, but are not so thick as to reach the surface; nor is the panel thickened through its whole extent. It fits exactly into the groove, and thickens gradually for an inch or two, and then sets off at a right angle with the surface, increasing suddenly three or four sixteenths of an inch. A panel may be raised on one side only, or on both sides. Flush panels are rebated down from one face to the distance the plough groove is in from the surface of the framing; and the back of a panel thus rebated on one side is worked down to be even with the other edge of the groove, leaving a tongue to fit it exactly; for if it be required to make panels flush on both sides, this is generally effected by filling in on the back or flattened side with an extraneous piece. Panels of external doors and shutters may be rendered more secure by boring them, and inserting iron wires, as noticed in the *Transactions of the Society of Arts*, vol. xxv. p. 106. Framing is not, however, often finished in the manner above described, especially with raised and flush panels; mouldings are generally introduced, and are either struck or worked in the solid substance of the framing, or are in separate pieces or slips, and laid in with brads. If a moulding be struck or laid in on one side only, and the other is left plain, the framing is described as moulded and square, a flat panel being in that case understood; if the panel be raised the framing will be described as moulded with a raised panel on one side, and square or flush on the other. It may be moulded with a flat panel, or moulded with a raised panel, on both sides; and the moulding may, as before intimated, be either struck in the solid or laid in any of the preceding cases. Mouldings which are laid in round the panels of framing are neatly mitred at the angles, and bradded, to appear as much as possible as if they were struck in the solid. In nailing or bradding the mouldings, the brads should be driven into the framework, and not into the panels. Framing with sunk panels, in some kinds of work, has the edges of the rails and styles either stop-chamfered or slightly curved. With a flush panel the moulding is always either a bead, or a series of beads called *reeds*; and is, in the case of a single bead, which is most common, always struck on the solid frame, and the work is called bead-flush; but reeds are generally struck on the panel in the direction of the grain, and laid in on the panel across it, or along the ends; this is termed reed-flush.

Flush panels in inferior works have a single bead struck on their sides in the direction of the grain alone, the ends abutting plainly, and this is termed bead-butt, the fact that the panels are flush being inferred.

The plainest quality of framing, in which it is square on both sides, is used in the fittings of inferior bed-rooms, inner closets, and the plainer domestic offices, but always internally; framing moulded on one or both sides, in rooms and places of a greater degree of importance, and in places where the work may be more generally seen; in some cases a flat panel may be enriched by a small moulding laid on its surface, leaving a margin between it and the larger moulding at its extremities. This may be done in drawing-rooms and apartments of that class, especially if they be in an upper story; and raised panels should be confined to the framed fittings of dining-rooms and other apartments on a ground or principal story. Framing with flush panels is almost restricted to external doors, &c., one side of a door being bead-flush, and the other flat and moulded, perhaps, or the face may be moulded with a raised panel, and the back bead-flush; and this for principal entrances. Bead-butt framing is found in external doors to offices, &c. Partitions between rooms are often made of framing as above described. Lately some sliding partitions have been put forward, one of which consists of two or three large sliding framings, and felt is relied upon to render them sound proof. This is by Stone; while that by Williams consists of a series of framings pivoted at top and bottom, and with the pivots running on grooves at top and bottom, so that the shutters may be formed into a pilaster-like mass at the side of the room.

It is of the utmost importance in framing that the tenons and mortises should be truly made. After a mortise has been made with the mortise chisel, it should be rendered perfectly even with a float,—an instrument which differs from a single cut or float file only by having larger teeth. An inexperienced workman often makes his work fit too tight in one place, and too easy in another, hence the mortise is split by driving the parts together, and the work is never firm; whereas if the tenon fill the mortise equally, without using any considerable force in driving the work together, it is found to be firm and sound. The thickness of tenons should be about one-fourth of that of the framing, and the width of a tenon should never exceed about five times its thickness, otherwise, in wedging, the tenon will become bent, and bulge out the sides of the mortise. If the rail be wide, two mortises should be made, with a space of solid wood between; fig. 80 shows the tenons for a wide rail. If the tenon occurs at the end of a piece of framing, it must be set back a little, so as to allow sufficient solid wood to form a sound mortise; this is called a haunching (see *e*, fig. 81). In thick framing, the strength and firmness of the joint is much increased by putting a cross or feather tongue in on each side of the tenon; these tongues are about an inch in depth, and are easily put in with a plough proper for such purposes. The projected figure of the end of a rail, as in fig. 80, shows these tongues put in; in the style there are grooves ploughed to receive them. Sometimes these projections are left in the solid wood itself, in which case they are called *stump tenons*. Sometimes, in thick framing, a double tenon in the thickness is made; but we give the preference to a single one, when tongues are put in the shoulders, as we have described; because a strong tenon is better than two weak ones, and there is less difficulty in fitting one than two. The panels of framing should be made to fill the grooves, so as not to rattle, and yet to allow the panels to shrink without splitting. When the mouldings are stuck on the framing, as is often the case in large stuff, it becomes necessary to find the lines to bring the angles together. In square framing, this is done simply by cutting *a b*, *c d*, as in fig. 81, at a mitre; but if the framing be oblique angle, it is done by scribing; the angle at *a b* being determined by the eye, *c d* is cut parallel to it. Where large projecting or bolection mouldings are used, the French have a very excellent way of framing (fig. 82), which it would be well to imitate in this country. Here C is the panel round which the moulding B is framed and mitred, the whole is then framed into A, which is a section both of the styles and rails. When a frame consists of curved pieces they are often joined by means of pieces of hard wood called keys. Fig 83 is the head of a Gothic window frame joined with a key, with a plan of the joint below it. A cross tongue is put in on each side of the key, and the joint is tightened by means of the wedges, *a*, *a*. It is, however, a better method to join such pieces by means of a screw bolt instead of a key, the cross tongues being used whichever method is adopted. Where the ends of the bolts cannot be allowed to project, they should be fixed as *bed bolts*.

Fig. 80.—Tenons for wide Railing.

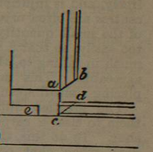


Fig. 81.—Fitting Mouldings to Framing.

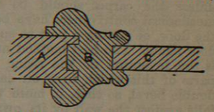


Fig. 82.—Bolection Mouldings.

Fig. 83.—Gothic Keyed Frame.

Doors are made two and four panelled for the most part when the panels are flat and the framing square, six-panelled when the latter is moulded, and six, eight (as figs. 2 and 3, Plate XXVI., to which the details in the following description will apply), or even ten-panelled when the framing is of the superior descriptions. Doors which are hung in two equal widths to occupy the doorway, and are hung to the opposite side posts or jambs of the frame, are said to be folding-doors or double-margined,—that is, the styles or margins are repeated necessarily in the middle where they meet. The style, muntin, and rails to doors are the same as in framing or wainscoting; and the panels may be moulded in the same manner. Doorways are fitted with jamb linings, and architraves or pilasters. Jamb linings, as A in fig. 86, when they exceed 9 or 10 inches in width, should always be so framed to correspond with the door on the outer faces; or they may be made solid. Narrow and plain jamb linings to inferior rooms are rebated on one side of the lining only, and the rebate forms the frame into which the door is fitted. To superior work they are rebated on both sides, as if it were intended to put a door on each side. The jambs are fixed to the inner edges of the grounds, which are fixed to the wall to receive the architrave or other decorations to the opening, and to stop the plastering; if they are wide, and not framed, backings are put across to stiffen them; and these backings are dovetailed into the edges of the grounds.

Doors.

It requires a considerable degree of care to hang a door, a shutter, or any other piece of work in the best manner. In the hinge, the pin should be perfectly straight, and truly cylindrical, and the parts accurately fitted together. The hinges should be placed so that their axes may be in