WITH ALL THE PRECISION POSSIBLE

André-Jacob Roubo

With All the Precision Possible

Roubo on Furniture Making

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Lost Art Press

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With All the Precision Possible: Roubo on Furniture Making
A translation of *L'Art du menuisier*

Published by Lost Art Press LLC in 2025
407 Madison Ave., Covington, KY 41011, USA
Web: http://lostartpress.com

ISBN: 978-1-954697-24-9

Editor: Christopher Schwarz
Copy editing: Megan Fitzpatrick, Kara Gebhart Uhl
Photography: E.M. Ginger/42-Line for the plates; Authors of essays for shop photos
Book design and production: Wesley B. Tanner/Passim Editions
Index: Suzanne Ellison
Distribution: John Hoffman

This book was printed & bound in the United States of America
Printing by Signature Book Printing, signature-book.com

In memory of Melvin J. Wachowiak Jr.

Friend, colleague and Fellow Traveler on the

road named "I wonder if..."

Donald C. Williams

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Annotations by Christopher Schwarz, Don Williams, Michael Mascelli, Philippe Lafargue and Jonathan Thornton noted in ***bold***

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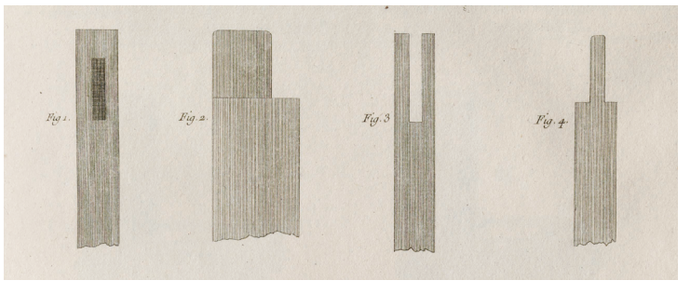
Samples of Joinery

The art of assembly [or joinery] is the most interesting part of joinery (with regard to its stability), and that which requires the most attention, especially on the part of its practitioners. Stability and exactness in construction of the joinery has given place to a number of different assemblies, which I am going to detail as exactly as is possible.

Joints in general are made with mortises and tenons, which make cavities in the thickness of the wood, which receive the tenons, and by their union assemble all the different pieces necessary for the construction of all sorts of works, and give them at the same time all the strength possible. Look at *Plate 8, Fig. 1*, which represents a mortise. That of *Fig. 3* represents an enfourchement [fork or bridle joint, open mortise-and-tenon], and those of *Figs. 2 & 4*, a tenon viewed flat and on edge, or on the front view and from the side view, which is the same thing.



We name the joints differently, following the diversity of cut, the decoration of the moulding of joinery, or the lack of these pieces. Therefore, we speak of joinery in woodworking by *mortise and tenons*, or *enfourchement* [forking], *squarely*, *miters*, on the *grain line*, in *false cut*, with *tenons and mortises*, and *double or simple forking*, etc.

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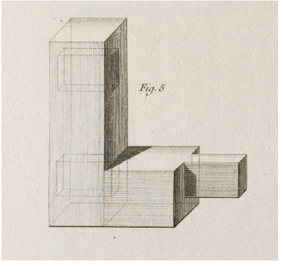

Squared assemblies are those where the two cut-outs [shoulders or cheeks] of the tenon are equal, *Fig. 5*. We call the two ends of the piece *errazement* [the cut-outs of open mortises] that supports the tenon, which joins to the piece in which is made the mortise.

Assemblies by enfourchements are those where the mortise and the tenon take up the whole length of the piece, and which have hardly

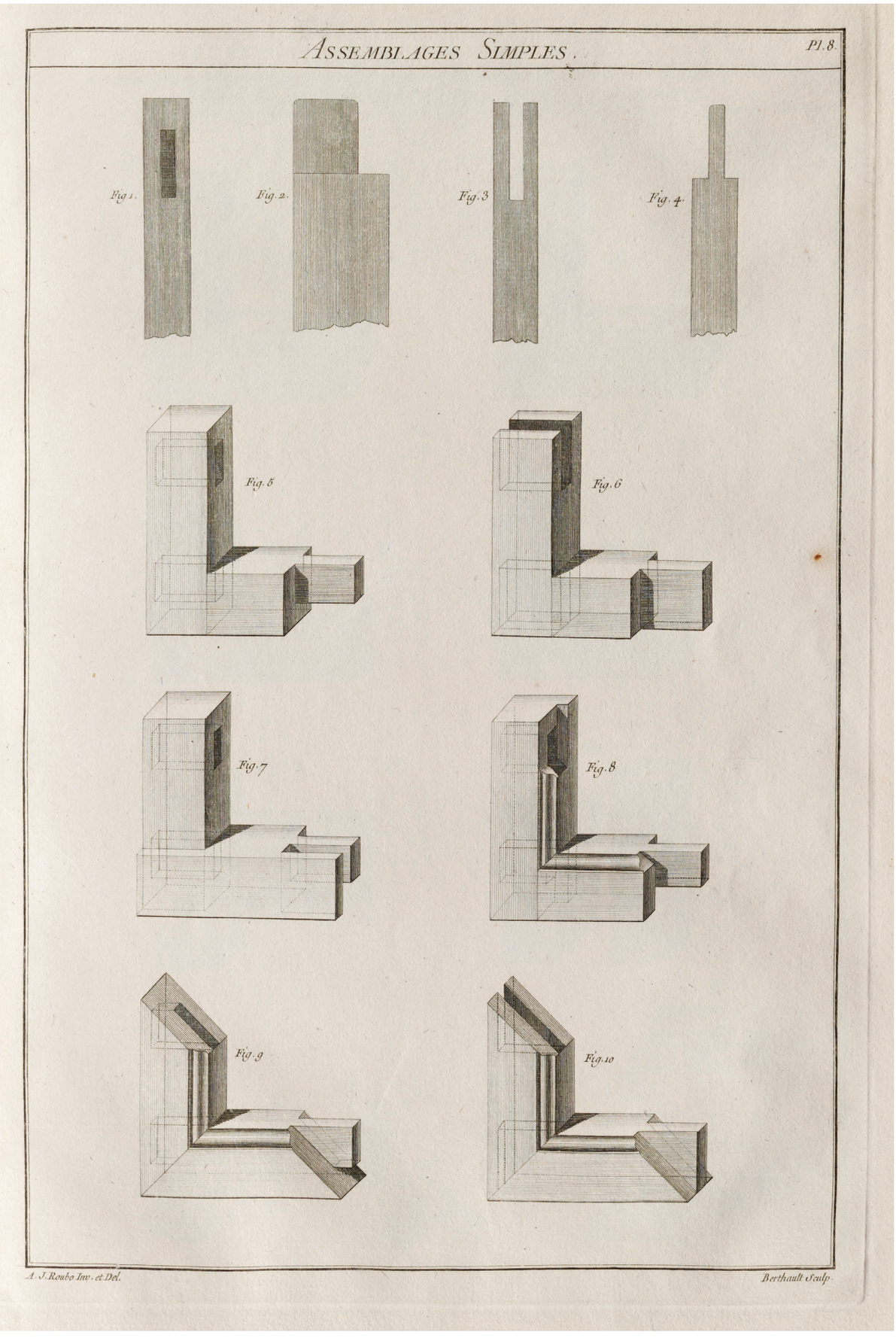

Plate 8. *Samples of Joinery*

any shoulder, *Fig. 6*. We call *shouldering* the little [pieces] of solid wood that you have between two mortises, or between a mortise and the end of the piece, where it follows that there are no mortises without shouldering, or better, if there are not any, it loses its name and is called *enfourchement* [bridle joint].

When one of the pieces of wood is thicker than the other, and you wish to retain the entire shouldering, you make an assembly by mortise and tenon, plus a forking with the rest of the thickness of the piece, *Fig. 7*.

We call assemblies *onglet* [mitered] when the woodwork is decorated [augmented] with mouldings. You extend the cut-out [errazement] of the tenon on the side of the moulding, the same width of this moulding, which Joiners call *growing a beard*. The distance from the cut-outs to the end of the lengthened beard is mitered, that is to say, at a 45° angle, *Fig. 8*.

Plate 8

When the work is of considerable esteem and consequently you wish to assemble it more cleanly, you cut not only the moulding at an angle but also the upright, so that the end wood does not show at either side, and is what we call that assembly *on grain*. This assembly is made by mortise or by forking, as is necessary, *Figs. 9 & 10*.

When you wish to give more strength to these assemblies and the thickness of the wood permits in the remaining part after the projection of the moulding, you join squarely and you make a protrusion of the moulding by forking, and you make a miter cut, *Fig. 1*.

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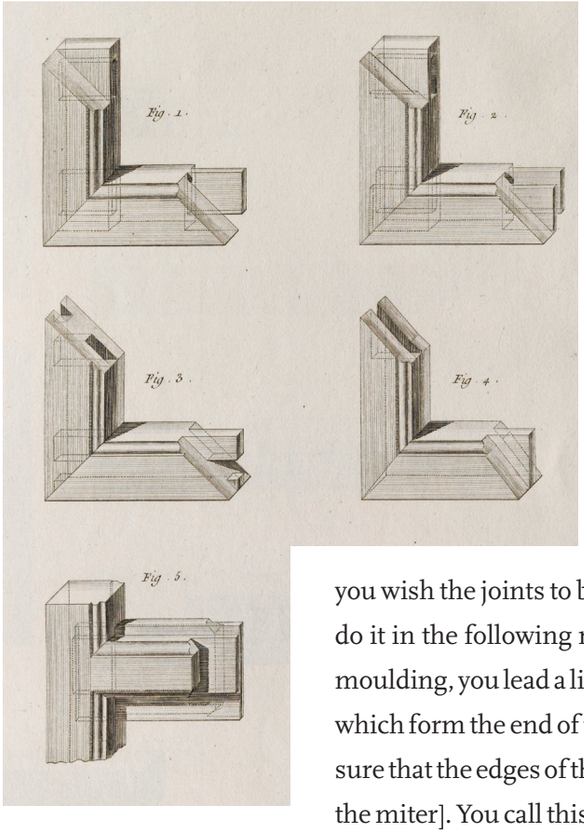
Plate 9
Doubled Assemblies and Dovetails



When the miter becomes too long after the first forking, you make a second one to give more strength to the work, *Fig. 2*.

When the on-grain cut is large, as in the case of a window frame or even a door frame, after the shouldering of the mortise, you make a little forking to prevent the joint from wiggling at its end, *Fig. 3*.

When the faces are unequal in width and you wish the joints to be on grain [all of the mitering on end grain], you do it in the following manner: After having miter-cut the width of the moulding, you lead a line from the miter just to the meeting of two lines which form the end of the faces, which makes the required cut [making sure that the edges of the corner abut precisely regardless of the angle of the miter]. You call this joint a *false cut, Fig. 4*.

It sometimes happens that you join pieces of different sizes in the same piece, and the thickness of the first two joints together equals that in which they are assembled. So you make a mortise of a size capable of holding the tenons of the two pieces joined together. This joint is named *a hanging tenon, Fig. 5*.

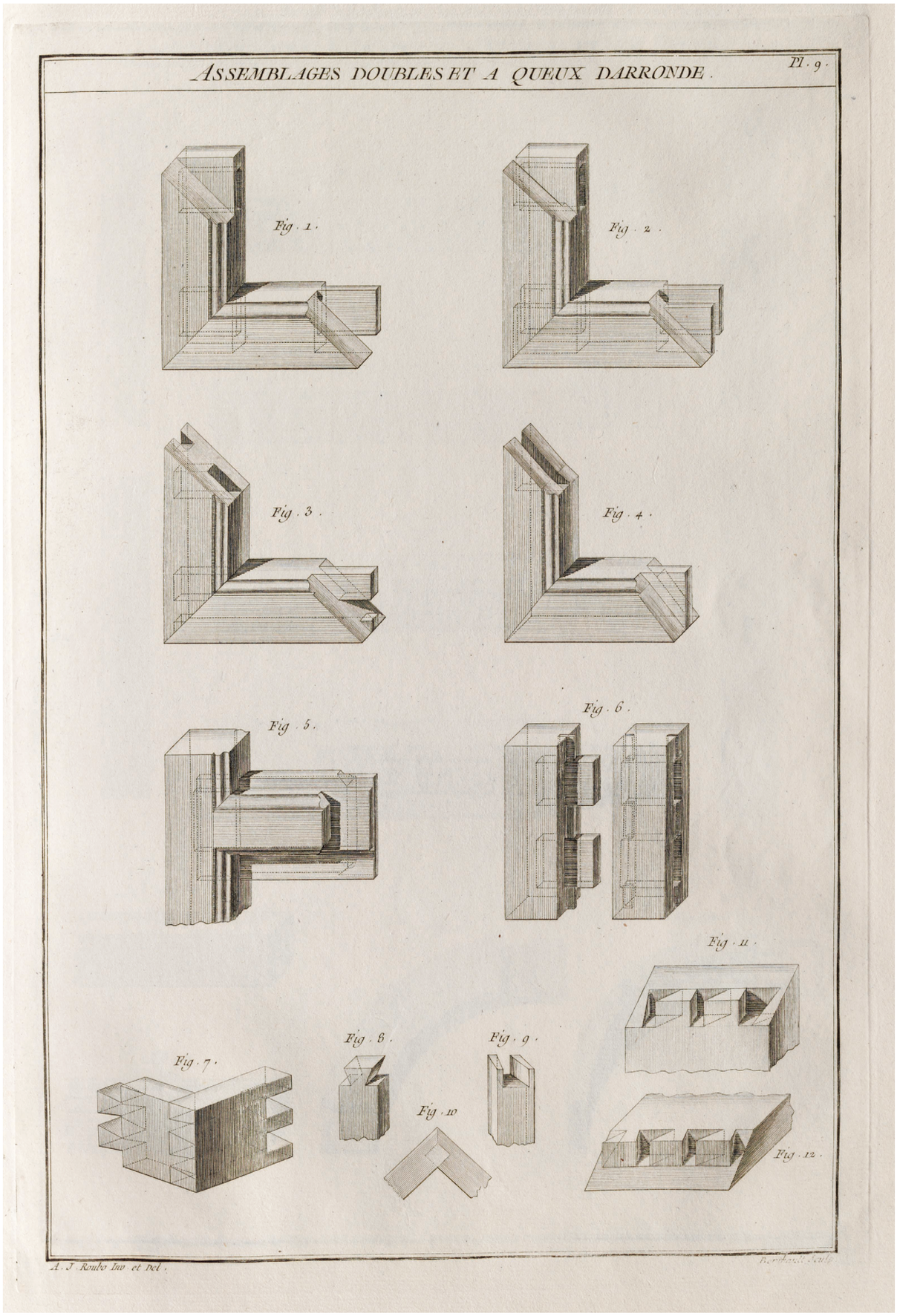


Plate 9. *Doubled Assemblies with Dovetails*

When you wish the work to be very solid, and the wood has enough thickness, you make two tenons in-line with each other, noting a cheek between them, without which the cross-piece is of two pieces, as in the figure above.

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When you wish to join some boards together and they are thick enough, you make in each of these boards some mortises in which you bring a common tenon to two boards which we call *keys*, which being pinned, hold the joint and prevent it coming apart [literally "ungluing"]. You again make in the middle of the thickness of these boards a very thin groove because too large a thickness eliminates strength in the joint, and the small tongue there will only prevent air from penetrating across the joint, *Fig. 6*.

Figure 7 represents a joint that is called a *rounded end* [*queue d'arrondes*, dovetail]. There are some notches of a widened [tapered] form which, when made with precision, hold two pieces of joined wood in a very solid way. Look at *Figs. 8 & 9*, where are represented an end and its notch separated from each other.

Covered ends or *hidden ends* [blind dovetails] are made for more precision. You establish the size of the joints, such that they are two-thirds or three-quarters of the thickness of the wood, and the rest being miter-cut. See *Figs. 10 , 11 & 12* that represent assembled covered ends [blind dovetails], and the same ends separated to see the insides.

Plate 9

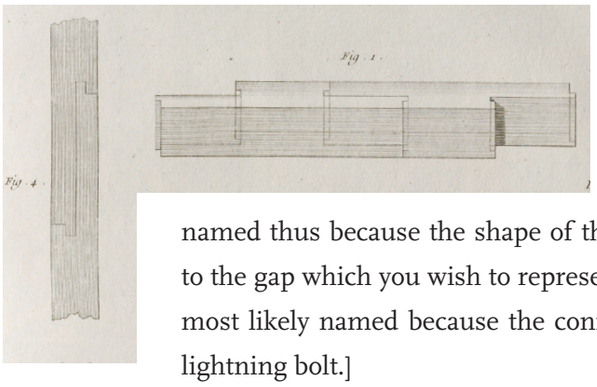
Section 1

Different Ways to Elongate Wood

The elongation of wood should also be put among the number of assemblages, its application being very useful, given the impossibility of always having wood of the necessary length, or supposing that it is, the defect being that they sometimes are not of a perfect quality along the entire length, but being corrected by this method.

Plate 10
Jupiter's Thunderbolt Joints for Lengthening

There are two ways to elongate wood: the first, by notching half of each piece with tongue and grooves at the ends of each piece of wood, which you hold together by means of glue and pegs, *Figs. 1 & 4*.



The second way to elongate the wood is with *Jupiter's thunderbolts* (apparently named thus because the shape of the cuts is a bit similar to that which you give to the gap which you wish to represent). [This is a notched and pegged scarf joint, most likely named because the configuration of the joint looks somewhat like a lightning bolt.]

There are two types of Jupiter's thunderbolts, one which you make by notching half of each piece and by forming a second notch to receive the [inserted tapered] key. One must note to make this second notch off-set toward the end of the piece, so that the key forced against it finds no resis-

tance in the opposite side of the other notch, and consequently it better draws the joints together [so that it acts like a draw pin], *Figs. 2 & 5*.

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The second way is to trace in the middle of the piece two parallel lines *a–b, c–d*, which give you the thickness of the notch. After having determined the length of the notch, and having traced the position of the key in the middle, you cut out all the wood from the front of the wood (assuming you are looking at the front of the notch) up to the first parallel line. From the position of the key up to distance *e*, you make a second notch *a–e*, such that in each piece, what there is more of takes the place of what there is less of in the depth of the notch, and makes space for the key. For the ends of these notches, they make tongue and grooves, or only an angle, but the little tongues are better, *Figs. 3,6 & 7*.

This second way is very strong, and is much better than the first because the key bears all the thickness, instead of the other way, which has only half as much. What's more, a key bearing only half [the thickness] is subject to rolling, and consequently to open the joint. Even if the joint does not open up, the key can be eaten up [word down] and forced, bearing on the opposite side of the groove, which loses its desired effect, see the figures above.

Plate 10

This assembly is very useful and very strong, and is in use not only by Joiners, but also by carpenters, as much for buildings as for ships.

When the entire length of the wood which you wish to elongate is taken up by mouldings, and you cannot or do not wish to make Jupiter's thunderbolts, for fear that the key and the grooves will not meet up in the mouldings, you use an assembly called a *flute*, or a *scarf joint*, which is made in this way.

After having divided the width of your piece into two equal parts, as indicated by line *f–f–g*, you make the length that you wish to give to your grooves by *h–i–l–m*. From this line to the end of your piece, you draw diagonals *r–o–p–i*, and *f–q–m–n*, some from one side of the line and the others from the other, such that these notches are made in two pieces with much precision, are at the same time a solid and very tight assembly. You must take care that these grooves be made going from right to left, so that when you wish to elaborate with mouldings, they will not be subject to splitting, *Fig. 8*.

Although I said that you must separate the piece into two pieces to make these types of notches, this rule is not however general. When you have many pieces of mouldings in the piece, you put the joint in the loosening of one from the other, if it is found in the middle, or in the middle of the groove, as you can see in *Fig. 9*.

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When you elongate pieces ornamented with mouldings using Jupiter's thunderbolts, you should take care to make notches according to the depth of the moulding, if there is not a groove, so that the key is not uncovered, *Fig. 10*.

You can also lengthen curved pieces, both on their face and on their edge, using Jupiter's thunderbolts, as indicated in *Figs. 11 & 12*. For as many pieces as are curved on the face, and for as little as they are curved, you should never make any tenons, because they will become too sliced up, and consequently less solid. You should fit them together by making at the end of the piece a forking

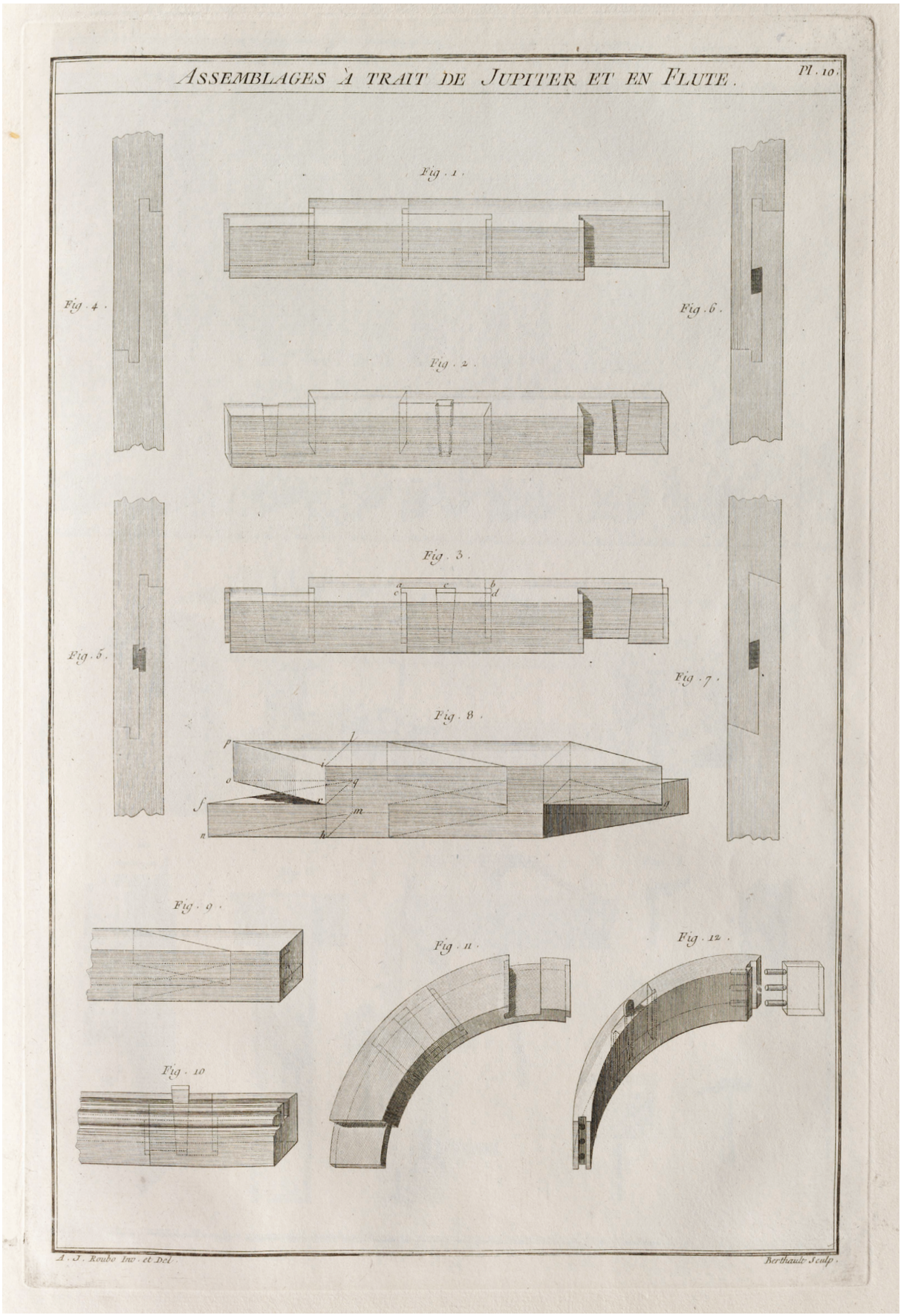
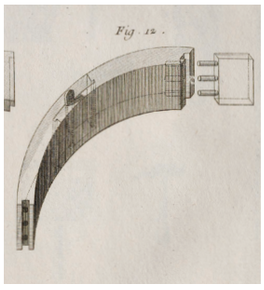


Plate 10. *Jupiter's Thunderbolt Joints for Lengthening*

of little depth and of the thickness of the tenon. In this forking you make three or four holes for placing pegs or dowels from the tenon that you fit together. These types of tenons are called *tenons a peignes* [toothed tenons, doweled tenons], *Fig. 12*.



There you have it, all the different assemblies that are used for the construction of joinery. I have detailed them the best that was possible for me; this matter, lifeless by itself, not being able to be rendered with as much clarity as I would have wished. You will have recourse to the plates where I have illustrated all the different assemblies, either joined or separated, so that you can see their effect better. I have also indicated all those that are hidden by punctuated lines. I hope that for as little as you may wish to pay attention, the demonstration that I have made will supplement that which one could find obscure in this discussion.

What I have said regarding joinery is only general, and I would take care that each piece of work that I would detail indicates those that are appropriate, their proportions and that which one should add to or subtract from.

Plate 10

I have put into plate XXIII [sic], all the scales upon which this work is done, so as to avoid redundancy, having sometimes up to three different scales in the same plate. I am therefore happy to show them, their use not being highly necessary, given that all the proportions are explained in the discussion.