the circle of which the flat of the floor is for med, may not make an angle with the parabola, it is necessary that its centre should be situatcd in some point S of the perpendi­cular to the parabola ER. To draw this perpendicular, the sub-normal must be made equal to half the parameter AN.

These methods are sufficient to show the nature of the mechanical systems of drawing the midship sections. We will proceed to give some of the mechanical systems of forming the sections of the fore and after bodies of ships. This operation affords a greater scope for ingenuity than the formation of the midship sections, and consequently the methods proposed have been much more numerous. The principal lines used in the construction of ships’ bodies by these methods are the main breadth-lines, the top breadth­lines, and the rising and breadth-lines of the floors. These lines are shown in two planes, a longitudinal vertical plane, and a longitudinal horizontal plane. The rising of the main breadth-line shows the projection on the longitudinal ver­tical plane of the heights above the upper side of the keel, at which are the greatest breadths of the different vertical sections fore and aft ; and the horizontal main breadth-line shows the corresponding distances from the middle line of the ship at the respective sections. The rising of the top breadth-line, and the horizontal top breadth-line, show in the same manner the heights from the upper side of the keel, and the horizontal distances from the middle line of the ship, of the different vertical sections at the top breadth of the timbers. At these heights, and at these distances from the middle line, arcs of circles are generally described, which give the form of parts of the vertical sections, or of the frames of the ship. The rising line of the floors gives in the same manner the heights above the upper side of the keel, and the horizontal breadth-line of the floors gives the distances from the middle line at which the floor-sweeps commence.

One of the oldest methods of forming a ship’s body is that which is called “ whole moulding.” It is a method of constructing the square body, that is, all the body except the fore and after extremities of a vessel, where the planes of the frames are placed obliquely to the middle line, by means of two moulds ; the upper one giving the form of the timbers above the rising line, and the lower one (called the “ floor-hollow”) giving the form of the timbers from the rising line to the keel. The midship section is first formed, usually by arcs of circles ; and at the height of the rising line in this section a horizontal tangent is drawn to this curve. In order that this tangent may be horizontal, the centre of the arc, forming the lower part of the curve, must be in a vertical line passing through the point at which the tangent is drawn. The lower part is formed by a sweep which reconciles with the upper curve. Usually this sweep does not correctly touch the upper curve, although the in­accuracy is not very important in this method of construc­tion. In forming the body-plan, the heights of the main breadth and rising lines at the different frames are set off, and the different sections drawn by the two moulds. On the horizontal part of the upper mould ABC (fig. 15) are marked the half main breadths of the different sections, as shown at C, and on the upper part of the mould their heights, as at A ; the lower mould DEF is also marked where it meets the side of the keel at the different sections.

In moulding any timber, a square, called the rising square, with the heights of the different risings of the timbers mark­ed on it, is used, by which the moulds are set according to the particular timber the form of which it is intended to obtain. On this square are also frequently marked the heights of the cutting down, by which the form of the in­side of the timber is obtained at the same time. The ope­ration of moulding a timber may be best seen by reference to the figure, where the moulds and rising square are set for moulding the lower futtock.

In Duhamel’s *Elémens de l'Architecture Navale,* there is a French method, nearly resembling this, of “ whole moulding.”

In Mungo Murray’s Treatise on Ship-building, a method is given for forming a ship’s body by the use of the sector. This instrument is formed of two scales connected by a hinge, so as to open and shut like a common rule. Seven lines are drawn on each leg of the sector from its centre, divided at numerous points, indicating lengths which refer to differents elements of the body. The marks on the cor­responding lines on the two legs of the sector refer to the same distances.

The lines on one side of the sector are divided for the fore-body, and on the other for the after-body. The man­ner of using these lines is thus described. “ The general dimensions being determined, and a scale adapted to the drawing, take the half breadth with a pair of compasses, and placing one foot in the proper point for the half breadth of the midship section, which is shown on one of the lines, open the sector till the other foot reaches to the same point in the corresponding line on the other leg.”

The sector being thus set, the different distances are taken by the compasses from the corresponding points mark­ed on the corresponding lines, and set off in the different plans.

It is immediately evident that, by the use of the sector as described, all ships constructed by it would be similar to that according to which the distances were marked on these lines. If it is required to form a fuller or a sharper body than that by which the lines of the sector were divided, the mid­ship section, with the foremost and aftermost sections, must be determined agreeably to the will of the constructor; and the intermediate sections will be determined on the diago­nals by setting the sector separately for each diagonal, and then taking the distances from the lines as before for the formation of the different plans in the drawing.

The next method of constructing ships\* bodies which we shall give is described by Bouguer ; the diagonals in this method arc formed of arcs of ellipses. The midship sec­tion is formed at will, and the extreme sections, forward and abaft, are formed in an arbitrary relation to the mid­ship section. To form the after-body by this method, let ABC (fig 16) represent the midship section, FED the after section, and BE the projection of one of the diagonals. Describe the arc of a circle BA (fig. 17) whose radius is equal to three times the line BE (fig. 16), and whose versed sine be is equal to BE. Divide the sine AC into any