form of a ship’s body, it will be necessary, in order, in the earliest steps, to confine the position of this point to cer­tain limits, to calculate the situations of the centres of gra­vity of the load water-section and of the midship section ; that these points, which will necessarily have great influ­ence on the position of the centre of gravity of the dis­placement, may be determined with reference to their in­fluence on the position of that point. These calculations are effected by a further application of the rules of approxi­mation already given.

Every transverse ordinate of the load-water Section be­ing bisected at its intersection with the vertical longitu­dinal section passing through the stem and stern-post, the centre of gravity of the load water-section will necessarily be in the line of these intersections ; it becomes therefore necessary only to find its position in this line. For the same reason, that of the bisection of the ordinates, the centre of gravity of the midship section will be in the line of its intersection with the vertical longitudinal section, passing through the stem and stern-post ; and it becomes therefore only necessary to determine its position in this vertical line. And again, the centre of gravity of displace­ment must be always in the same before-mentioned verti­cal longitudinal section, unless the vessel be inclined from the upright, which consideration does not enter into the present question ; it becomes therefore necessary to find its position in this section. In respect to length, this will be found in the line of intersection of some one of the trans­verse vertical sections with this vertical longitudinal sec­tion ; and in respect to depth, in the line of intersection of some one of the horizontal sections with this same vertical longitudinal section ; and, consequently, the position of this centre of gravity of the displacement, or, as some writers call it, the “ centre of buoyancy,” will be in the point of intersection of the three planes.

In order to determine the positions of these several centres of gravity, we must make use of this proposition in mecha­nics. If perpendiculars be drawn from any number of bodies to a given plane, the sum of the products of each body, multiplied by its perpendicular distance from the plane, is equal to the product of the sum of all the bodies multiplied by the perpendicular distance of their common centre of gravity from the same plane ; and also of its corollary, that if any of the bodies lie on the other side of the plane, their distances must be reckoned as being nega­tive. In applying this theorem to find the centre of gra­vity of any curvilinear space, by the application of either of the before-mentioned rules of approximation, each ordi­nate must be multiplied by its perpendicular distance from some given line, usually in a section near one of the extre­mities of the vessel : these products are then used as ordi­nates, and the rule is applied, and the calculations made, in the same manner as for finding the area of a space, the re­sult, however, being the moment of the space. The mo­ment of the space on the opposite or negative side of the line that was assumed from which to measure the perpen­dicular distances of the ordinates, is calculated by the ap­plication of the same means if the area be large ; if small, a more simple method will easily suggest itself, and the moment thus obtained is subtracted from the former mo­ment ; the remainder is the total moment of the space, es­timated from the assumed line, and this, divided by the total area of the same space, will give the distance of its centre of gravity from the assumed line. In this manner the centres of gravity of the load water-section and of the midship section may be found.

The position of the centre of gravity of the displacement is found by the application of the same rule of approxima­tion. In order to determine its vertical distance below the load water-section, a series of equidistant horizontal sec­tions must be drawn ; then the area of each successive ho­

rizontal section is multiplied by its perpendicular distance below the load water-section, and these products are used as ordinates in either of the rules. The result is the mo­ment of the space between -the load water-section and the lowest horizontal section ; to this must be added the mi­ment of that part of the body which is below the lowest ho­rizontal section. This will be obtained by multiplying its solid content into the vertical depth of its centre of gra­vity below the load water-section ; the sum of these two moments is the moment of the whole displacement, esti­mated from the load water-section ; and this moment, di­vided by the total displacement, will g[ve the vertical dis­tance of its centre of gravity below that load water-section. The position longitudinally of the centre of gravity of the displacement is obtained in a similar manner, by calculat­ing the moment of that part of the displacement which is situatcd before some one of the transverse vertical sections, and also the moment of that part of the displacement situ­ated on the opposite or negative side of the same section ; then subtracting the negative moment from the positive, the remainder, which is the moment of the whole displace­ment estimated from the assumed vertical section, divided by the total displacement, will give the distance of its centre of gravity from the assumed vertical section.

Instead of multiplying each ordinate by its perpendicu­lar distance from the given line or plane, it is more convc­nient to multiply the successive ordinates by 1, 2, 3, 4, &c., and the sum of these products by the common distance be­tween the ordinates, which of course produces the same re­sult. A little consideration, in the course of performing the foregoing calculations, will suggest methods by which some of the labour may be lightened ; such as the arrange­ment of the results in tabular forms, and the connecting the calculations for determining the areas, contents, or moments of those portions of the curves or solids towards the extre­mities with the general calculations. The foregoing ac­count of the method of making the above calculations is given merely as an outline. For some of the more minute details, see Inman’s Notes to Chapman ; and mature consi­deration of the principles on which the calculations are founded will suggest all that can be further required.

The constructor having completed the foregoing calcu­lations, will have ascertained the area of the midship sec­tion, the area of the load water-section, the displacement, the positions of the centres of gravity of these two sections, and also tl>e position of the centre of gravity of the dis­placement. The areas of the two sections, and the posi­tions of their respective centres of gravity, were required to be determined, on account of the influence of these areas and these positions on the content of the displacement, and the position of its centre of gravity, and also in con­sequence of their influence on the stability of the ship. It must therefore be remembered, that if the results of these previous calculations do not accord with the intentions of the constructor, or are inadequate to the development of his design, he must make such alterations in his curves or in his dimensions as he may consider necessary, before pro­ceeding further with his design. And if he shall have suf­ficiently informed himself on the theory of ships, he will be enabled to do so with considerable confidence at this stage of his progress, as to the final result of his work.

We have before said that a body floating on a fluid is supported by the upward pressure of that fluid. This body will be in equilibrio when the direction of this upward pres­sure passes through the centre of gravity of the part of the body which is immersed in the fluid, and also through the centre of gravity of the body. These two centres will therefore be in the same vertical line, and this vertical line will be the line of intersection of the transverse verti­cal section in which the centres of gravity of the displace­ment and of the body are situated, with the longitudinal