seven to nine inches above the load water-section. We shall, in its proper place in this article, describe the manner of finding experimentally the position of the centre of gra­vity of a ship, merely here premising, it is assumed gene­rally, that in ships of war the centre of gravity is rather above the load water-section.

In almost all classes of vessels, several of the transverse vertical sections on each side of the midship section are si­milar and equal to it, and generally the form of these sec­tions is such, that there would be but little disturbance, dur­ing the inclination of the ship, in the adjustments of the solids of immersion and emersion ; but the sections before and abaft these, as they approach the extremities, become more dissimilar in those portions of them above and below the load water-section ; consequently, although, as has before been said, the total volumes of immersion and emersion must necessarily be equal, the areas of the sections of the immersed and emerged solids, at any given transverse ver­tical section of the body, need not be equal ; it becomes there­fore necessary to determine the position of the intersection of the inclined load water-section with the load water-sec­tion of the ship in her upright position.

Suppose G (fig. 1) to be the centre of gravity of the ship, A B the water-line when she is upright, and let it cut the ver­tical line GC in the point D. From the centre of gravity G draw GY, making the angle DGY equal to the supposed angle of inclination of the ship. Take GY equal to GD, and through the point Y draw the line OR perpendicular to GY. Then OR is the water-line which the ship will assume after the in­clination. Let this inclined water-line intersect the water­line AB in the point S. Through D draw NM paral­lel to OR. It is clear that, supposing the centres of gra­vity of the solids of immersion and emersion to be in the same transverse section, in every vertical transverse sec­tion of the ship the distance DS will be the same, and the several points S, S, S, will be in the straight line forming the intersection of the two load water-sections, which line of intersection will be parallel to the longitudinal axis. Now, if, by a calculation of the contents of the solids of immer­sion and emersion, which are represented in the figure by the triangles ASR and BSO, which contents may be calcu­lated by either of the rides for approximation, they are not found to be equal, they must be altered until they become so. In order to find the position of the point S, or the dis­tance DS, we have the area ASR equal to the area BSO, which call equal to A, and let the area DSRM = *a,* and the area DSON = *b,*

then ADM = A + *a,* BDN = *A—b* and ADM— BDN *= a+b =* MNOR = MN × ST nearly, = MN × DS × sin. of inclin.

or DS = ADM — BDN/MN × sin. of inclin.

In order to obtain the areas of the sections of the pris­matic solids, chords may be drawn in each, which will di­vide it into two others, a triangular and a parabolic area. The triangular area will be equal to half the product of the base multiplied into its perpendicular height. The para­bolic

area will be equal to two thirds the base multiplied in­to its perpendicular height. The moment of each of these areas may then be found by taking the sum of the product of the area of the triangle multiplied into the distance of its centre of gravity, estimated along the inclined line from the point S ; and that of the product of the parabolic area multiplied into the distance of its centre of gravity, also estimated along the inclined line from the point S.

We have said, that when a ship is floating in equilibrium on a fluid, the vertical upward pressure of the fluid acts in the straight line passing through the centres of gravity both of the displacemcnt and of the vessel ; but that when she is inclined by the action of any force, as that of the wind, the centre of gravity of the displacement is carried to lee ward of its former position ; and as the vertical pressure up­wards of the fluid still takes place at the centre of gravity of the displacement, its direction should also pass to leeward of the position of the centre of gravity ; and thus a force is generated the tendency of which is to enable the ship to recover her upright position. We will now investigate the expression for the value of this force, in order to show the principle on which the actual calculation of its amount in ships is necessarily founded.

*Investigation of a General Expression for the Stabiliti/ of a Ship, and Description of the Method of calculating the Stability.*

Let ABC (fig. 2) be the midship section of a ship, and

AC the line of its intersection with the surface of the water. Suppose *ac* to be the same line when the ship is inclined, K being the point of intersection of the two lines. Now, by the inclination of the ship, of which we have taken the midship section to be a representative, a solid will be im­mersed on the lee side of the longitudinal axis, and an equal solid emerged on the weather side of the same axis. Call these solids respectively I and E, and suppose them to be concentrated in their respective centres of gravity. Let the horizontal distance between the centres of gravity of these two solids be *b.* Then, since the inclination of the ship has had the effect of taking the solid E from the dis­placement on the weather side of the middle line, and has added the solid I to the displacement on the lee side of the middle line, the same effect is produced as if the solid E had been transferred to I ; and the moment produced by this transfer, which would be *b*I or *b*E, is the moment which is actually produced in the horizontal direction along the dis­tance *b.*

Let G be the centre of gravity of the ship, F the centre of gravity of the displacement when the ship is upright, G