the body of the vessel to be divided, at the vertical trans­verse section passing through the centre of gravity of the displacement, into two, the fore and after bodies; then, if the depths of the centres of gravity of the displacements of the two parts of the vessel below the assumed water-line be determined, a line joining these centres of gravity will ne­cessarily be nearly parallel to the seat which the vessel will assume in the water.

Tables have been formed by Mr Cradock, a member of the late School of Naval Architecture, for facilitating the stowage of the ballast in ships, in order that they may sail at a determinate trim. These tables, being deduced from vari­ous ships in her majesty’s service, afford approximations for similar vessels ; but when there is a dissimilarity in size and form, we quote from the preliminary remarks to the tables, “ in order to place the ballast in such a position, that when all the weights are on board no alteration in it shall be ne­cessary. The difference between the light draught of water, and that to which it may be proposed to bring the ship when fully equipped, being known, the centre of gravity of this part of the displacement may be found. And if through this point a transverse vertical plane be supposed to pass, the ballast must be so placed that its moment from it, to­gether with the moments from the same plane of all the other weights put on board, may be cqual to nothing.” The length of these calculations is a convincing proof of the value of such approximating tables.

It is almost an universal custom in all vessels to give a greater draught of water abaft than forward. Occasional attempts have been made to discontinue this practice, as in­volving a supposed unnecessary increase in the water re­quired for floating a ship ; but the increased draught of water for the after-body has been reverted to as essentially requi­site in practice.

There are several minor advantages which result from this arrangement ; such as the more easy and unchecked flow of the water to the rudder, and its consequent increased effect in governing the motions of the ship ; also the di­minution of the negative resistance which tne vessel would otherwise experience from the greater difficulty with which the flow of water would fill the vacuity caused by the pas­sage of the vessel, if the fulness of the after-body were such as would be required to preserve an even draught of water; and again, the adjustment of the resultant of the resistance of the water to that position of the masts which experience has determined to be requisite for the facility of manoeuvring the sails. But the principal reason for the inequality in the draught of water appears to be the advantage which results from it to the more easy regulation of the motions of the vessel by an adjustment of the resultant of the resistance of the water on the lee side when on a wind.

This will be more apparent in a future portion of this ar­ticle, in which we shall consider the forces which act on a ship when in motion. The idea intended to be conveyed is, tl>at the flatness of the after-body along the deadwood may be considered as a reserve of lateral resistance, to be brought into operation whenever the pressure of the water on the lee-bow would otherwise draw the resultant of the water too far forward.

The dimensions of the merchant-shipping of England have been so shackled by the operation of the tonnage laws, that it is in vain to expect to find in their proportions any ap­proximation even to those which experience has proved are most advantageous for safety and for velocity. We take the following table from Hedderwick's Treatise on Marine Architecture, which being the most modem work on the mercantile navy, we presume contains details of the most modem practice.

“ Sloop Margaret, 60 tons, breadth to length as 34∙8 to 100. “ Smack Regent, 142 tons, breadth to length as 34∙2 to 100. “ Smack Matchless, 170 tons, breadth to length as 33∙4 to 100.

“ Smack Royal Sovereign, 204 tons, breadth to length as 32∙0 to 100.

“Schooner Charlotte, 101 tons, breadth to length as 31·5 to 100.

“ Schooner Glasgow, 155 tons, breadth to length as 31∙0 to 100.

“ Brig Down Castle, 149 tons, breadth to length as 30∙0 to 100. “ Brig William Young, 303 tons, breadth to length as 28∙6 to 100.

“ Ship Mary, 368 tons, breadth to length as 27∙9 to 100. “ Ship Albion, 505 tons, breadth to length as 2540 to 100.

“ The average depth of the sloops and smacks is about five ninths of their breadth ; schooners and brigs, from se­ven twelfths to three fourths ; and large brigs and ships, from three fourths to two thirds.”

This immense proportionate depth is the natural result of the old rule for calculating the tonnage ; according to which tonnage the worth of the ship was estimated, anil all the dues and duties levied. The rule involved only the di­mensions of length and breadth, and consequently left the depth to be increased without limit, or rather with no other limit than the depth of the harbours the vessel was destined to trade to. Now, Chapman, in the *Architectura Navalis Mercatoria,* gives an expression to which he says the velocity may be considered proportional : it is \_\_\_\_\_\_ ; in which B represents the breadth, L the length, and D the depth to the bilge ; from which expression it is evident the depth is the dimension the most detrimental to the velocity. Valu­able tables of some of the elements of design of the present classes of merchant-ships have been published by Mr Par­sons, formerly of the Sch∞l of Naval Architecture, under the title of Scales of Displacements.

*Investigation of the Forces which act on a Ship when in Motion, as they influence her Form and Qualities.*

We have now described the methods by which the seve­ral calculations for determining the elements of the design for a ship may be performed ; and have also pointed out, in general terms, the dependence of the several principal di­mensions upon each other, and their respective influence on the qualities of a vessel. We shall proceed to offer some more particular remarks on the forces of the wind on the sails and of the water on the hull when the ship is in motion, and investigate some of the principal phenomena of their action ; as it is only by a consideration of the in­fluence of these forces on the motions of the vessel that the naval architect can form a correct idea of the essential requisites for the design of a ship’s body, or the position or proportion of the masts, the area of the sails, and the posi­tion of their centre of effort. The investigations into which we shall enter in this portion of the subject may perhaps be found in some cases equally useful to the sailor as to the naval architect, as he will trace in them the means for de­veloping the powers of the vessel he may command, or of obviating by the appropriate remedy any error inherent to her design or equipment.

The motion of pitching is generally the most violent ac­tion to which a ship is subjected, and the most injurious, both to the connection between the parts of her structure, and the velocity of her sailing. It is the longitudinal mo­tion, caused by the variable support afforded to the body by the waves as the vessel passes over them when on a wind, and by the constant action of the gravity of the unsupported part of the body to recover the state of equi­librium which, before the commencement of the motion, had existed between it and the buoyancy of the fluid. The motion will continue as long as the course of the vessel remains the same in relation to the set of the seas, and