ly happens, that a ship may in one voyage possess very bad, and in another very good qualities, or at one time be a very bad sailer, and at another a very good sailer.

The natural inference from this is, that although the form of a ship should be that which is the best adapted for all that may be necessary to the service for which she is in­tended, it by no means follows that such a ship shall realize the intentions of her constructor, unless she be equipped and commanded by persons equal to the task of properly developing her qualities.

He then proves that, by assuming the load displacements, the crew and provisions as the expense, and the weight of a round of shot as the effect, that it is the greatest economy to have large ships and heavy metal. Repeating the ob­servation already made, that all ships forming a line-of- battle, although of different sizes, must act as parts of the same machine, and must consequently have the same qua­lities, which cannot be effected if the ships be similar, it follows that the rules by which they are designed must be of such a nature that they shall be capable of giving similar qualities to dissimilar ships.

He says the displacement is dependent wholly on the total weight of the armament, and then considers the va­rious items making up the total displacement. It consists of the weight of the armament, and of every thing connect­ed with it ; then the weight of the ballast, which is in pro­portion to the armament. Ballast, he says, is necessary for a ship of the line, in order to preserve its qualities at the end of a long voyage, when the greater part of the provi­sions and ammunition will have been consumed. Also, as these weights are so considerable that the ship may be lightened to such an extent that her centre of gravity may not only rise a foot higher above the water from this dimi­nished immersion than it was at the commencement of the cruise, but will rise so much the more from the influence this diminution of the weights in the hold will have in ele­vating its position, the stability is also necessarily diminish­ed. It is therefore proper, in order that this loss of stabi­lity may not be too great, to have such a quantity of bal­last that the remaining weight in the hold may not be too little in relation to the constant weight above the water. And also, he says that the consideration that a ship neces­sarily lightens from the consumption of stores, renders it necessary that all the calculations which relate to her sta­bility should be made in relation to a water-line, assumed as that which she would have after the expiration of about a quarter of the cruise ; and it should be from this water­line that the masts, &c. should be determined.

The next component of the displacement consists of the provisions, which are in proportion to the crew, and there­fore to the armament ; and, lastly, the ship, with her masts, yards, rigging, anchors, cables, fitting, &c. &c.

Having determined the displacement required for the ar­mament, the next considerations arc the length and breadth. These have hitherto been determined by the number of ports, the space between them, and the space forward and aft ; but they should be determined from the displacement, for the product of the number of guns into their weight determines the displacement, therefore the displacement determines the length. If the length resulting from this be considered too great for the number of ports, it is be­cause the sum-total of the weights of the guns being given and constant, it follows that if each gun be of greater weight of metal, the number is smaller ; and if each gun be of less weight of metal, the number is larger ; but the length of the ship is nevertheless the same.

It appears that, from experiments made in Sweden in the year 1794, it was determined that the effect of the water on the after-end of a body, in opposing its progress, is a mi­nimum when the surface of the body makes an angle of 13° 17' with its middle line, and that consequently Chap­man designed the after-bodies of his ships in accordance with this result.

In order to form general rules, according to the exponen­tial system, for deducing the length and the breadth from the displacement, he proceeded in the following manner. The greatest breadth at the water-line for all line-of-battle ships is called B ; and the length of the “ construction water-line,” which term will be afterwards explained, is called *l.* Then, he says, “ designs of two classes of ships composing the line-of-battle were constructed with great care, and the following table formed.”

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | 110 | 94 | 60 |
| Displacement, D | **... —** | 152075 | 128297 | 88722 |
| Length, *I* |  | 207·59 | 196·65 | 175·48 |
| Breadth, B |  | 56·27 | 53·32 | 48·46 |

In finding the length *l* from the displacement for all ships of the line, the ships of ninety-four and sixty-six guns have been used. Put therefore 128297 = D, and 88722 = *D,* also 196∙65 = I and 175∙48 = Z, where it will be seen that the Roman characters are used for the larger ship, and the Italic for the smaller. Then from the foregoing reason­ing the following proportion is deduced, that

D’ : *D,* : : 1 : *l ;* hence

, log. 1 — log. Z

the exponent =

\_ log. 196·65 — log. 175∙48

- log. 128297 —log. 88722

196’65 2∙2936940 128297 5’1082165

175∙48 2∙2442276 88722. 4∙9480313

0∙0494664 0Ί601852

= 0,3088 *= v*

0.1601852

2∙2936940 5∙1082165×0∙3088=l∙5774172

0∙7162768...5∙2033 = the co-efficient. 2-2442276

4∙9480313×0∙3088 = 1’5279520.. .5∙2033 = the co efficient

Thus the length Z = 5∙2033 D030β8 is obtained for all the line-of-battle ships.

To find the breadth B from the length Z for three-decked ships the same method is used. Thus, the exponent for , .. log. 56-27 —log. 53∙32

110 and 94 gun sh.ps, *v = log. 207.59 \_ log. 196.tj5* = 0∙9947 ; and as the co-efficient is found to be a divisor = 3∙5863, the breadth B for all three-decked ships of the

*1*0 99«

lme = ^3∙5863'

To find the breadth B from the length Z for two-decked ships. The exponent *v* of ships of 94 and 66 guns,

log. 53∙32 — log. 48∙46 nQQO, . .. a

= Γog∏9fr65^o⅛T7M8 = θ’8391 5

cient is a divisor = 1∙5767, the breadth B for all two-deck- *1***0'8391**

ed ships of the fine = **~~1~~~~.~~~~57~~~~gγ~~** » according to which the fol­lowing table is calculated.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | 110 | **94** | 80 | 74 | 66 | 52 |
| Displacement, D = | 152875 | 128297 | 107400 | 96422 | 88722 | 66753 |
| Length, *I..........* . — | 207·59 | 196·65 | 186·15 | 180·05 | 175·48 | 160·72 |
| B — | 56∙27 | 53·32 | 50·92 | 49·51 | 48·46 | 45·01 |
|  |  | |  |  |  |  |

Having explained the method of determining the prin­cipal dimensions, we shall refer for a description of the pa­rabolic system of construction to the paper we have already