perfect theory is the result of the perfection of the science, rather than that the perfection of the science results from the theory. To argue against this principle, would be to retrograde from the nineteenth to the sixteenth century, and to affirm that Bacon has lived in vain.

We shall, in as concise a manner as is consistent with clearness of explanation, detail the method of performing the calculations necessary to determine the essential ele­ments of the design of a ship’s body, in the course of pre­paring the original draught or drawing.

A body floating at rest, upon a fluid also at rest, displa­ces as much of the fluid as is equal to the weight of the body. The truth of this proposition will appear from the consider­ation that the equilibrium between the body and the fluid is maintained by precisely the same upward pressure as sup­ported the fluid which the body has displaced ; and as the same pressure must support the same weight when there is an equilibrium, the weight of the floating body must be equal to that of a quantity of fluid equal in bulk to that part of the body which is immersed. It follows that the weight of the water displaced by a ship floating on it at rest, is equal to the weight of the ship and all its contents.

It is usual to call the weight of the quantity of water which a ship displaces when she is floating at rest, her dis­placement; or, in other words, according to the foregoing proposition, the term displacement applied to a ship is sy­nonymous with her weight.

To obtain, therefore, the total weight of a ship, it is only necessary to ascertain the weight of the volume of water which she displaces when floating at rest. This is found by calculating the number of cubic feet contained in a homo­geneous solid equal in bulk to that part of the body below the surface of the water, and then multiplying this number by the specific gravity of the water, that is, by the weight of one cubic foot : the result will be the weight of the water displaced, and consequently also that of the ship.

That a ship of war may be able to carry and to maintain effective, in ordinary circumstances of weather, a determin­ed armament, or a merchant-ship a certain lading, it is evi­dent that the weight of the ship, and all that she is destined to contain, must be in such proportion to her bulk that she shall not be so far immersed in the water as to render her armament inefficient under circumstances in which its effi­ciency may be required ; or her lading oppressive to her, if lading be the purport of her construction. The bulk of a ship is in proportion to her length, her breadth, and her depth. This, when the naval architect has ascertained the displacement necessary for his ship to possess, is his first guide to proportion her dimensions, so as to insure that dis­placement without undue immersion. The next step is to determine the form and area of a transverse vertical sec­tion at the largest part of the ship’s body, which generally extends from the middle of the length for some distance towards each extremity. This section is called the midship section, and on its area is principally dependent the direct resistance which the vessel will experience, while the sta­bility or resistance to inclination, and the easiness or un­easiness of her motions, are greatly dependent on its form. Having to a certain extent fixed upon the midship section, the next consideration is to determine the area and form of a horizontal section at the surface of the water. This section is called the load water-section, or sometimes the “ plane of flotation.” On this section also the stability of the ship, in proportion to her dimensions, is very greatly dependent, as will be seen when we more fully explain that quality. The depth in the water, and the shape of the verti­cal section through the longitudinal axis of the ship, should next be determined ; and then transverse vertical sections of the body between the midship section and either ex­tremity of the vessel, generally at those parts where the body is intended to alter materially from the form of its

midship section to that of the more sudden curvature at the extremities. An important consideration is involved in the forms of these sections, considerably influencing the easi­ness of the ship’s motions. At present it will be enough to mention them as the next progressive step in the design ; after which the constructor has data sufficient to determine whether the dimensions he has chosen will enable him to obtain adequate displacemcnt for the services required of his vessel. If so, he may proceed to trace in intermediate sections, and thus gradually, letting his design keep pace with his calculations, complete his drawing by the aid of processes which will be fully explained in a subsequent por­tion of this article, and which we therefore shall wholly omit here, as the limits of our space will not admit of repe­tition. Also, we can hardly describe the method of pro­ceeding with the drawing until the principles which ought to guide us in forming the design have been investigated.

As we are totally unacquainted with the course of the fluid along the bottom of a vessel, it is essentia) that the curves bounding diagonal sections, called diagonal lines, and the curves bounding vertical sections, called buttock and bow lines, should be attentively considered, and also the curves bounding the inclined water-sections, that they may be such as, by comparison with other and acknowledged fast ships, may be presumed to be conducive to velocity. It must constantly be remembered, that naval architecture is a science of comparisons and of analogies ; and no pains must be spared in rendering them subservient, not only to the design in progress, but to the eventual perfection of the science.

An important consideration connected with the forming the design of a ship is involved in the gradual alteration of the vessel’s seat in the water from the consumption of stores, lt is not only essential that a ship should be pos­sessed of stability combined with easiness of motion, be weatherly and quick in manoeuvring when she is stored and completed for foreign service as a ship of war, or fully laden as a merchant-ship ; but it is equally essential that she should be possessed of these qualities towards the expi­ration of her cruize, or on her return light from her voyage. Designs for ships to be as perfect as the present state of knowledge can make them, must be made with reference to several water-lines.

We see, therefore, that there are difficulties opposed to the improvement of the forms of merchant-ships, which do not exist to the same extent in opposition to the improve­ment of the forms of ships of war.

In the designing of ships of war, the nature of the service in which they will be employed is known, and the lading, in comparison with that of a merchant-ship, is a constant quantity : it is therefore only necessary to endeavour to ob­tain a maximum of good qualities in relation to these cir­cumstances. But in a merchant-ship the lading is of such a variable nature, both as to quantity and species, that the ship is at different times under very different circumstances ; yet she is subjected to the same trials. Thus an East India- man,on her outward voyage, is two feet more immersed than on her homeward ; and the draught of water of a collier is reduced, at different times, four, five, or six feet, by which the stability is generally very much diminished ; and even with the same draught of water the stability may vary very considerably, owing to the difference in the nature and dis­position of the lading, and the consequent effect produced on the centre of gravity of the ship ; and yet, under these different circumstances, the ships are exposed to the same winds and seas. It is evident that if, when at their pro­per draught of water and stowage, they are only equal to the trials to which they are subject, they must be very in­adequate to the contest with such a deduction from their powers as this would produce ; particularly if their design be not made with a due consideration of this circumstance.