riences in her passage through the water. A practical confirmation of the correctness of this principle, and of the fact that this generally advantageous position of the rudder is a-lee of the middle line of the ship, may be drawn from the common observation, that when a ship is in good trim, the helm, being a-weather, has a very perceptible tremulous motion, which must arise from the rudder’s being in a position in which it is not acted upon on either side by any constant force. This method of considering the direction of the flow of the water to the rudder consider­ably diminishes the estimate of the excess of its effect on the lee side of the rudder over that on the weather. But there are several other considerations which operate in in­creasing the effect of the weather-helm. From the direc­tion in which the water flows past the ship, there will be a much greater reduction of pressure on the weather side of the rudder when the helm is to windward, and therefore a greater positive pressure on its lee side to turn the ship, than will occur under the opposite circumstances, or when the helm is a-lee. Also, the broken and disturbed state of the water on the after-part of the weather side of the ship, and the consequent various degrees of resistance it opposes, must lessen its effect when the helm is a-lee.

It has been said to be proved by practice, that ships which carry lee-helms cannot be weatherly, that is, will fall faster to leeward than those which carry weather helms. But though the fact is correct, the reason assigned is in some degree mistaking the effect for the cause. It has be­fore been said that a part of the force of the wind acts in driving a ship bodily to leeward ; of course its effect will be greater or less in proportion to the lateral resistance oppos­ed to it, and the ship which opposes less lateral and greater longitudinal resistance to the water than another, will in the same period of time have fallen farthest to leeward, and the line of her course will have made a larger angle with her middle line, by which the effect of the water on the after-part of the lee side is increased, while that on the fore-part, both of the lee and weather sides, is diminished, and the helm must consequently be kept less a-weather. A practical proof of the correctness of this reasoning may be drawn from the practice of the merchant-vessels, which are generally, from form, more leewardly than men-of-war. They have their fore-mast placed much nearer the centre of the ship than is usual in sharper and finer formed bodies. This has evidently arisen from the operation of the cause above mentioned, which has shown that they require the resultant of the effort of the wind on the sails to be pro­portionately farther aft to insure their carrying a weather-helm. From this reasoning it is evident that, under some circumstances, it may be the leewardliness of the ship which causes her to carry a lee-helm ; and that when such is the case, the defect might be remedied, not only by the usual methods of placing the masts farther aft, and altering the draught of water, but by increasing the lateral resistance by the addition of false keel, or by greater depth in the water.

There is another disadvantage arising from a ship’s car­rying a lee-helm, which is, that the action of the water on the weather side of the rudder acts in conjunction with the force of the wind in forcing the ship bodily to lee ward ; while, on the contrary, when the helm is a-weather, the action of the water on the rudder is in opposition to the force of the wind.

Having now pointed out wherein the necessity consists, that a ship should carry a weather helm under all circum­stances, and explained the principles by which the position of the helm is governed, it next remains to consider in what manner this position of the rudder may be affected when the ship is under sail. This is the more neccssary, be­cause there are occasions in which ships that generally carry good helms will carry them a-lee ; it therefore also remains to be examined whether this defect might not either be wholly removed, or at least ameliorated.

The ardency of a ship, which is her tendency to fly to the wind, depends, as has been explained, on the relative posi­tions of the resultant of the effort of the wind on the sails, and the resultant of the resistance of the water on the hull. A consideration of the effects produced on these forces, when a ship is under way, will lead to the object of our inquiry.

When a body passes through a fluid, it causes an accu­mulation of the fluid to take place towards its foremost ex­tremity, and a depression of the fluid towards the opposite. The degree of this accumulation and depression will depend on the velocity with which the body passes through the fluid, and its increase must necessarily have a great effect in drawing the position of the resultant of the water farther forward ; therefore, from this cause, a ship becomes more ardent as her velocity is increased. Also, as the ship on a wind inclines by the force which communicates motion to her, an increased surface of the bow is immersed ; while, from the fulness of its shape both above and below the ori­ginal water-line, the angle of incidence with which it meets the water does not undergo much alteration : consequently the tendency of the inclination is to draw the resultant of the water forward, in so far as the shape of the bow is in­volved. By the inclination, the effect of the water on the after upper portion of the lee-side is so diminished as to be almost destroyed, in consequence of the decrease of the angle of incidence with which it meets the water, arising from the sharpness of the after-body under the lee quarter, which, by the inclination, is made to approximate to a ho­rizontal plane : consequently the tendency of the inclina­tion is to draw the resultant of the water forward, in so far as the shape of this part of the body is involved. That lower portion of the after-body which is nearly vertical when the ship is upright, and, until the vessel is on a wind, is subjected to little more than the mere friction of the wa­ter, immediately that a ship is on a wind offers great late­ral resistance, even after the inclination of the ship ; and it is this lateral resistance of the after-body which, being brought into action simultaneously with the increased di­rect resistance of the fore-body, tends to prevent too great an effect from that direct resistance in drawing the result­ant of the water forward, and therefore acts in aid of the helm in preventing the ship from flying up into the wind, and thus obviates the necessity of such violent action of the rudder as would be injurious to the velocity of the ship.

The larger the area of this portion of the after-body, the less necessity therefore is there for extreme and conse­quently detrimental action of the rudder under the circum­stances of increased wind and inclination. It appears, how­ever, that in ships generally, the inclination increases the ardency, by drawing the resultant of the water forward.

This train of reasoning shows us in what the advantage consists which arises from the increased immersion given to the after-extremities of ships ; and it enables us to form the following general rule, as an approximation to correct­ness of principle in determining the increased draught of water to be given to the after-body. The difference in draught of water should increase or diminish in proportion as the area which a ship offers to direct resistance is great or small in relation to the area offered to lateral resistance ; or, in general terms, the difference of draught of water in ships, *cæteris paribus,* should vary directly as the ratio which the breadth bears to the length.

The position of the centre of effort of the wind on the sails is calculated under the supposition that the sails are plane surfaces, and equally disposed with regard to the lon­gitudinal axis of the ship ; but when a ship is on a wind, as the force of the wind acts in a direction oblique to the surface of the sails, a greater proportion of the sail is carried to leeward of this axis, and the whole sail assumes a curved surface, the curvature of which increases from the weather to the lee side. From these circumstances, the centre of