be conſidered as a lever, acted on in different parts by forces in different directions, and the whole balancing each other round that point or axis where the equiva­lent of all the reſiſting forces paſſes. This may be conſidered as a point ſupported by this reſiſting force, and as a fort of fulcrum: therefore, in order that the ſhip may maintain her poſition, the energies or momenta of all the impelling forces round this point muſt balance each other.

When a ſhip fails right afore the wind, with her yards ſquare, it is evident that the impulſes on each ſide of the keel are equal, as alſo their mechanical *momenta* round any axis paſſing perpendicularly through the keel. So are the actions of the water on her bows. But when ſhe ſails on an oblique courſe, with her yards braced up on either ſide, ſhe ſuſtains a preſſure in the direction CI (fig. 5.) perpendicular to the ſail. This, by giving her a lateral preſſure LI, as well as a preſſure CL ahead, cauſes her to make leeway, and to move in a line C*b* inclined to CB. By this means the balance of action on the two bows is deſtroyed; the general impulſe on the lee-bow is increaſed; and that on the wea­ther-bow is diminiſhed. The combined impulſe is there­fore no longer in the direction BC, but (in the ſtate of uniform motion) in the direction IC.

Suppoſe that in an inſtant the whole ſails are annihi­lated and the impelling preſſure CI, which preciſely ba­lanced the reſiſting preſſure on the bows, removed. The ſhip tends, by her inertia, to proceed in the direction C*b.* This tendency produces a continuation of the reſiſtance in the oppoſite direction IC, which is not di­rectly oppoſed to the tendency of the ſhip in the direc­tion C*b;* therefore the ſhip’s head would immediately come up to the wind. The experienced ſeaman will re­collect ſomething like this when the ſails are ſuddenly lowered when coming to anchor. It does not hap­pen ſolely from the obliquity of the action on the bows: It would happen to the parallelopiped of fig. 2. which was ſuſtaining a lateral impulſion B ∙ sin.2 *x,* and a direct impulsion A∙ cos.2 *x.* Theſe are continued for a mo­ment after the annihilation of the ſail; but being no longer oppoſed by a force in the direction CD, but by a force in the direction C*b,* the force B ∙ sin.2 *x* muſt prevail, and the body is not only retarded in its motion, but its head turns towards the wind. But this effect of the leeway is greatly increaſed by the curved form of the ſhip’s bows. This occaſions the centre of effort of all the impulſions of the water on the lee ſide of the ſhip to be very far forward, and this ſo much the more remarkably as ſhe is ſharper afore. It is in general not much abaft the foremaſt. Now the centre of the ſhip’s tendency to continue her motion is the ſame with her centre of gravity, and this is generally but a little be­fore the mainmaſt. She is therefore in the ſame con­dition nearly as if ſhe were puſhed at the mainmaſt in a direction parallel to C*b,* and at the foremaſt by a force parallel to IC. The evident conſequence of this is a tendency to come up to the wind. This is inde­pendent of all ſituation of the ſails, provided only that they have been trimmed obliquely.

This tendency of the ſhip’s head to windward is call­ed griping in the ſeaman’s language, and is greateſt in ſhips which are ſharp forward, as we have ſaid al­ready. This circumſtance is eaſily underſtood. What­ever is the direction of the ſhip’s motion, the abſolute impulſe on that part of the bow immediately contigu­ous to B is perpendicular to that very part of the ſurface. The more acute, therefore, that the angle of the bow is, the more will the impulſe on that part be per­pendicular to the keel, and the greater will be its ener­gy to turn the head to windward.

Thus we are enabled to underſtand or to ſee the pro­priety of the diſpoſition of the ſails of a ſhip. We fee her crowded with ſails forward, and even many ſails ex­tended far before her bow, ſuch as the ſpritſail, the bowſprit topſail, the fore-topmaſt ſtaylarl, the jib, and flying jib. The ſails abaft are comparatively ſmaller. The ſails on the mizenmaſt are much smaller than those on the foremast. All the ſtayſails hoiſted on the main­maſt may be conſidered as headſails, becauſe their cen­tres of effort are conſiderably before the centre of gra­vity of the ſhip; and notwithſtanding this diſpoſition, it generally requires a ſmall action of the rudder to counteract the windward tendency of the lee-bow. This is conſidered as a good quality when moderate; be­cauſe it enables the ſeaman to throw the ſails aback, and flop the ſhip’s way in a moment, if ſhe be in danger from any thing ahead; and the ſhip which does not carry a little of a weather helm, is always a dull ſailer.

In order to judge ſomewhat morc accurately of the action of the water and ſails, suppoſe the ſhip AB (fig. 9.) to have its ſails on the mizenmaſt D, the mainmaſt E, and foremaſt F, braced up or trimmed alike, and that the three lines D*i,* Et, Ff, perpendi­cular to the ſails, are in the proportion of the impulſes on the ſails. The ſhip is driven ahead and to leeward, and moves in the path *a*C*b.* This path is ſo inclined to the line of the keel that the medium direction of the reſiſtance of the water is parallel to the direction of the impulſe. A line CI may be drawn parallel to the lines Di, E*e,* Ff, and equal to their ſum: and it may be drawn from ſuch a point C, that the actions on all the parts of the hull between C and B may balance the *momenta* of all the actions on the hull between C and A. This point may juſtly be called the *centre of effort,* or the *centre oſ resistance.* We cannot determine this point for want of a proper theory of the reſiſtance of fluids. Nay, although experiments like thoſe of the Pariſian academy ſhould give us the most perfect knowledge of the intenſity of the oblique impulſes on a ſquare foot, we ſhould hardly be benefited by them: for the action of the water on a ſquare foot of the hull at *p,* for inſtance, is ſo modified by the intervention of the ſtream of wa­ter which has ſtruck the hull about B, and glided along the bow B *op,* that the preſſure on p is totally different from what it would have been were it a ſquare foot or ſurface detached from the reſt, and preſented in the ſame poſition to the water moving in the direction *bC.* For it is found, that the resiſtances given to planes join­ed ſo as to form a wedge, or to curved ſurfaces, are widely different from the accumulated reſiſtances, calcu­lated for their ſeparate parts, agreeably to the experi­ments of the academy on ſingle ſurfaces. We there­fore do not attempt to aſcertain the point C by theory; but it may be accurately determined by the experiments which we have ſo ſtrongly recommended; and we offer this as an additional inducement for proſecuting them.

Draw through C a line perpendicular to CI, that is, parallel to the ſails; and let the lines of impulſe of the