**from the truth; that** is, the direct and lateral reſiſtances will be nearly in the proportion of CI to ID.

It reſults from this view of the matter, that the lee­way is in general much ſmaller than what the uſual theory aſſigns.

We alſo ſee, that according to whatever law the reſiſtances change by a change of inclination, the leeway remains the ſame while the trim of the sails is the ſame. The leeway depends only on the direction of the impulſe of the wind; and this depends ſolely on the poſition of the ſails with reſpect to the keel, whatever may be the direction of the wind. This is a very important obſervation, and will be frequently referred to in the progreſs of the preſent inveſtigation. Note, however, that we are here conſidering only the action on the ſails, and on the ſame ſails. We are not conſidering the ac­tion of the wind on the hull and rigging. This may be very conſiderable; and it is always in a lee direction, and augments the leeway; and its influence mult be ſo much the more ſenſible as it bears a greater proportion to the impulſe on the ſails. A ſhip under courtes, or cloſe-reefed topſails and courtes, muſt make more lee­way than when under all her canvas trimmed to the ſame angle. But to introduce this additional cauſe of deviation here would render the inveſtigation too com­plicated to be of any uſe.

This doctrine will be conſiderably illuſtrated by at­tending to the manner in which a lighter is tracked along a canal, or ſwings to its anchor in a ſtream. The track rope is made faſt to ſome ſtaple or bolt E on the deck (fig. 2.), and is paffed between two of the timber- heads of the bow at D, and laid hold of at F on ſhore. The men or cattle walk along the path FG, the rope keeps extended in the direction DF, and the lighter ar­ranges itſelf in an oblique poſition AB, and is thus dragged along in the direction *ab,* parallel to the ſide of the canal. Or, if the canal has a current in the op­poſite direction *ba,* the lighter may be kept ſteady in its place by the rope DF made faſt to a poſt at F. In this caſe, it is always obſerved that the lighter ſwings in a poſition AB, which is oblique to the ſtream *ab* Now the force which retains it in this poſition, and which preciſely balances the action of the ſtream, is cer­tainly exerted in the direction DF; and the lighter would be held in the ſame manner if the rope were made faſt at C amidſhip, without any dependence on the timberheads at D; and it would ſtill be held in the ſame poſition, if, inſtead of the single rope CF, it were riding by two ropes CG and CH, of which CH is in a direction right ahead, but oblique to the ſtream, and the other CG is perpendicular to CH or AB. And, drawing DI and DK perpendicular to AB and CG, the ſtrain on the rope CH is to that on the rope CG as CI to CK. The action of the rope in these caſes is preciſely analogous to that of the ſail *y*Y; and the obliquity of the keel to the direction of the mo­tion, or to the direction oſ the ſtream, is analogous to the leeway. All this muſt be evident to any perſon accuſtomed to mechanical diſquiſitions.

A moſt important uſe may be made of this illuſtration. If an accurate model be made of a ſhip, and if it be placed in a ſtream of water, and ridden in this manner by a rope made faſt at any point D of the bow, it will arrange itſelf in ſome determined poſition AB. There will be **a** certain obliquity to the ſtream, meaſured by the angle *Bob;* and there will be a correſponding obliquity of the rope, meaſured by the angle FCB. Let yCY be perpendicular to CF. Then CY will be the poſition of the yard, or trim of the ſails cor­responding to the leeway *b*CB. Then, if we ſhift the rope to a point of the bow diſtant from D by a ſmall quantity, we ſhall obtain a new poſition of the ſhip, both with reſpect to the ſtream and the rope; and in this way may be obtained the relation between the poſition of the ſails and the leeway, independent of all theory, and ſuſceptible of great accuracy; and this may be done with a variety of models ſuited to the moſt uſual forms of ſhips.

In farther thinking on this ſubject, we are perſuaded that theſe experiments, inſtead of being made on mo­dels, may with equal eaſe be made on a ſhip of any ſize. Let the ſhip ride in a ſtream at a mooring D (fig. 3.) by means of a ſhort hawter BCD from her bow, ha­ving a ſpring AC on it carried out from her quarter. She will ſwing to her moorings, till ſhe ranges herſelf in a certain poſition AB with reſpect to the direction *a b* of the ſtream; and the direction of the hawſer DC will point to ſome point E of the line of the keel. Now, it is plain to any perſon acquainted with mechanical diſ­quiſitions, that the deviation BE*b* is preciſely the lee­way that the ſhip will make when the average poſition of the ſails is that of the line GEH perpendicular to ED; at leaſt this will give the leeway which is produ­ced by the ſails alone. By heaving on the ſpring, the knot C may be brought into any other poſition we pleaſe; and for every new poſition of the knot the ſhip will take a new poſition with reſpect to the ſtream and to the hawſer. And we perſiſt in ſaying, that more in­formation will be got by this train of experiments than from any mathematical theory: for all theories of the impulſes of fluids muſt proceed on phyſical poſtulates with reſpect to the motions of the filaments, which are exceedingly conjectural.

And it muſt now be farther obſerved, that the ſubſtitution which we have made of an oblong parallelopiped for a ſhip, although well ſuited to give us clear no­tions of the ſubject, is of ſmall uſe in practice: for it is next to impoſſible (even granting the theory of oblique impulſions) to make this ſubſtitution. A ſhip is of a form which is not reducible to equations; and therefore the action of the water on her bow or broadſide can only be had by a moſt laborious and intricate calcula­tion for almoſt every ſquare foot of its ſurface. (See *Bezout's Cours de Mathem.* vol. 5. p. 72, &c.) And this muſt be different for every ſhip. But, which is more unlucky, when we have got a parallelopiped which will have the ſame proportion of direct and lateral reſiſtance for a particular angle of leeway, it will not anſwer for another leeway of the ſame ſhip; for when the leeway changes, the figure actually expoſed to the ac­tion of the water changes alſo. When the leeway is increated, more of the lee-quarter is acted on by the water, and a part of the weather-bow is now removed from its action. Another parallelopiped muſt therefore be diſcovered, whoſ reſiſtances ſhall ſuit this new poſition of the keel with reſpect to the real courte of the ſhip.

We therefore beg leaveto recommend this train of experiments to the notice of the Association for the Im­provement of Naval Architecture as a very promiſing method for ascertaining this important point. And