each other by the intervention of the ſhip, in the ſame manner as the goods and the weights balance each other in the ſcales by the intervention of a beam or ſteel- yard.

When a ſhip proceeds ſteadily in her courſe, without changing her rate of ſailing, or varying the direction of her head, we muſt in the firſt place conceive the accu­mulated impulſes of the wind on all her ſails as preciſely equal and directly oppoſite to the impulſe of the wa­ter on her bows. In the next place, becauſe the ſhip does not change the direction of her keel, ſhe reſembles the balanced ſteelyard, in which the energies of the two weights, which tend to produce rotations in oppoſite directions, and thus to change the poſition of the beam, mutually balance each other round the fulcrum; ſo the energies of the actions of the wind on the different ſails balance the energies of the water on the different parts of the hull.

The ſeaman has two principal taſks to perform. The firſt is to keep the ſhip ſteadily in that courſe which will bring her fartheſt on in the line of her intended voyage. This is frequently very different from that line, and the choice of the beſt courſe is ſometimes a matter of conſiderable difficulty. It is ſometimes poſſible to ſhape the courſe precisely along the line of the voyage; and yet the intelligent ſeaman knows that he will arrive ſooner, or with greater ſafety, at his port, by taking a different courſe; becauſe he will gain more by increaſing his ſpeed than he loſes by increaſing the diſtance. Some principle muſt direct him in the ſelection of this courſe. This we muſt attempt to lay be­fore the reader.

Having choſen ſuch a courſe as he thinks moſt ad­vantageous, he muſt ſet ſuch a quantity of ſail as the ſtrength of the wind will allow him to carry with ſafe­ty and effect, and muſt trim the ſails properly, or ſo adjuſt their poſitions to the direction of the wind, that they may have the greateſt poſſible tendency to impel the ſhip in the line of her courſe, and to keep her ſtea­dily in that direction.

His other taſk is to produce any deviations which he ſees proper from the preſent courſe of the ſhip; and to produce theſe in the moſt certain, the ſafeſt, and the moſt expeditious manner. It is chiefly in this move­ment that the mechanical nature of a ſhip comes into view, and it is here that the ſuperior addreſs and reſource of an expert ſeaman is to be perceived.

Under the article Sailing ſome notice has been taken of the firſt taſk of the ſeaman, and it was there ſhown how a ſhip, after having taken up her anchor and fitted her ſails, accelerates her motion, by degrees which continually diminiſh, till the increaſing reſiſtance of the water becomes preciſely equal to the diminiſhed impulſe of the wind, and then the motion continues uniformly the ſame ſo long as the wind continues to blow with the ſame force and in the ſame direction.

It is perfectly conſonant to experience that the im­pulſe of fluids is in the duplicate ratio of the relative ve­locity. Let it be ſuppoſed that when water moves one foot per ſecond its perpendicular preſſure or impulſe on a ſquare foot is *m* pounds. Then, if it be moving with the velocity V eſtimated in feet per ſecond, its perpen­dicular impulſe on a ſurface S, containing any number of ſquare feet, muſt be *m*SV2

In like manner, the impulſe of air on the ſame ſurface may be repreſented by nSV2; and the proportion of the impulſe of theſe two fluids will be that of m to n*.* We may expreſs this by the ratio of q to I, making m/n = q.

M. Bouguer’s computations and tables are on the ſuppoſition that the impulſe of ſea-water moving one foot per ſecond is 23 ounces on a ſquare foot, and that the impulſe of the wind is the ſame when it blows at the rate of 24 feet per ſecond. Theſe meaſures are all French. They by no means agree with the experi­ments of others; and what we have already ſaid, when treating of the *Resistance of Fluids,* is enough to ſhow us that nothing like preciſe meaſures can be ex­pected. It was ſhown as the reſult of a rational inveſtigation, and confirmed by the experiments oſ Buat and others, that the impulſions and reſiſtances at the ſame ſurface, with the ſame obliquity of incidence and the ſame velocity of motion, are different according to the form and ſituation of the adjoining parts. Thus the total reſiſtance of a thin board is greater than that of a long priſm, having this board for its front or bow, &c.

We are greatly at a loſs what to give as abſolute mea­ſures of theſe impulſions.

1. With reſpect to water. The experiments of the French academy on a priſm two feet broad and deep and four feet long, indicate a reſiſtance of 0,973 pounds avoirdupois to a ſquare foot, moving with the velocity of one foot per ſecond at the ſurface of ſtill water.

Mr Buat’s experiments on a ſquare foot wholly immerſed in a ſtream were as follows:

A ſquare foot as a thin plate - 1,81 pounds.

Ditto as the front of a box one foot long - 1,42

Ditto as the front of a box three feet long - 1,29

The reſiſtance of ſea-water is about 1/25 greater.

2. With reſpect to air, the varieties are as great.

The reſiſtance of a ſquare foot to air moving with the velocity of one foot per ſecond appears from Mr Ro­bins’s experiments on 16 ſquare inches to be on a ſquare foot - 0,001596 pounds,

Chevalier Borda’s on 16 inches - 0,001757

on 81 inches - 0,002042

Mr Rouſe’s on large ſurfaces - 0,002291

Preciſe meaſures are not to be expected, nor are they neceſſary in this inquiry. Here we are chiefly intereſted in their proportions, as they may be varied by their mode of action in the different circumſtances of obliqui­ty and velocity.

We begin by recurring to the fundamental propoſition concerning the impulſe of fluids, viz. that the abſo­lute preſſure is always in a direction perpendicular to the impelled ſurface, whatever may be the direction of the ſtream of fluid. We muſt therefore illuſtrate the doctrine, by always ſuppoſing a flat ſurface of fail ſtretched on a yard, which can be braced about in any direction, and giving this ſail ſuch a poſition and ſuch an extent of ſurface that the impulſe on it may be the ſame both as to direction and intenſity with that on the real ſails. Thus the conſideration is greatly Ampli­fied. The direction of the impulſe is therefore perpen­dicular to the yard. Its intenſity depends on the ve-