for diſcovering the velocity of the wind. Let the di­rection of the vane at the mast-head be very accurately noticed on both tacks, and let the velocity of the ſhip be alſo accurately meaſured. The angle between the directions of the ſhip’s head on theſe different tacks be­ing halved, will give the real direction of the wind, which muſt be compared with the poſition of the vane in order to determine the angle contained between the real and apparent directions of the wind or the angle EC*e;* or half of the obſerved ſhifting of the wind will ſhow the inclination of its true and apparent directions. This being found, the proportion of EC to FC (fig. 6.) is eaſily meaſured.

We have been very particular on this point, becauſe ſince the mutual actions of bodies depend on their rela­tive motions only, we ſhould make prodigious miſtakes if we eſtimated the action of the wind by its real direc­tion and velocity, when they differ ſo much from the relative or apparent.

We now reſume the inveſtigation of the velocity of the ſhip (fig. 4. ), having its sail at right angles to the keel, and the wind blowing in the direction and with, the velocity CE, while the ſhip proceeds in the direc­tion of the keel with the velocity CF. Produce Ee, which is parallel to BC, till it meet the yard in *g,* and draw FG perpendicular to E*g.* Let *a* repreſent the angle WCD, contained between the sail and the real direction of the wind, and let *b* be the angle of trim DCB. CE the velocity of the wind was expreſſed by V, and CF the velocity of the ſhip by *v.*

The abſolute impulſe on the ſail is (by the uſual theory) proportional to the ſquare of the relative velo­city, and to the ſquare of the sine of the angle of inci­dence; that is, to FE2 × sin.2 wCD. Now the angle GFE = *w*C D, and EG is equal to FE × sin. GFE; and EG is equal to E*g — g*G. But E*g = z*EC × sin. ECg — V × sin. *a*; and *g*G — CF, = *v.* Therefore EG = VX sin. *a—ν,* and the impulſe is proportional to V × sin. *a — v2.* If S repreſent the ſurface of the ſail, the impulſe, in pounds, will be *n*S (V × ſin. *a—v)2*.

Let A be the ſurface which, when it meets the wa­ter perpendicularly with the velocity *v,* will ſuſtain the same preſſure or reſiſtance which the bows of the ſhip actually meets with. This impulſe, in pounds, will be mAv2. Therefore, becauſe we are conſidering the ſhip’s motion as in a ſtate of uniformity, the two preſſures balance each other; and therefore *mAv2 — nS* (V × ſin. *a—v*)2, and m/n Av2 — S (V × ſin. *a—v)2;*

therefore *—* √m/n*× ν =* √*s* × V × ſin. *a—v* √S,

*n*

√ S×v× sin. *a* V × ſin. a V'× ſin. a and *v \_ ∕m .* ∕m A , = \*A +

√Va+√S √ 7s+ i^s+1∙

We ſee, in the firſt place, that the velocity of the ſhip is *(caeteris paribus)* proportional to the velocity of the wind, and to the ſine of its incidence on the ſail jointly; for while the ſurface of the ſail S and the equivalent ſurface for the bows remains the ſame, *v* increaſes or diminiſhes at the ſame rate with V ·sin. *a —* When the wind is right aſtern, the sine of a is unity,

V and then the ſhip’s velocity is ∕% A

√ r⅛-+1∙\_

Note, that the denominator of this fraction is a com­mon number; for *m* and *n* are numbers, and A and S being quantities of one kind, A/S is alſo a number.

It muſt alſo be carefully attended to, that S expreſſes a quantity of ſail actually receiving wind with the in­clination *a.* It will not always be true, therefore, that the velocity will increaſe as the wind is more abaft, becauſe some ſails will then becalm others. This obſervation is not, however, of great importance; for it is very unuſual to put a ſhip in the ſituation conſidered hither­to; that is, with the yards ſquare, unless ſhe be right before the wind.

If we would diſcover the relation between the velo­city and the quantity of ſail in this simple case of the wind right aft, obſerve that the equation *ν =*

—0 + 1 *n* 0

gives us ∕m τ'4-Dc: V, and ∕rn *v^zDJ— ν,* ν Vs^ *nS*

and »=v∑L^ζ\*, and -1 1 ; and becauſe

*n S m* A ( V —*ν j*

*n* and *m* and A are conſtant quantities, S is propor­tional to —or the ſurface of ſail is proportional

( V—v)2, to the ſquare of the ſhip’s velocity directly, and to the ſquare of the relative velocity inverſely. Thus, if a ſhip be ſailing with of the velocity of the wind, and we would have her ſail with 1/4 of it, we muſt quadruple the ſails. This is more eaſily ſeen in another way. The velocity of the ſhip is proportional to the velocity of the wind; and therefore the relative velocity is alſo propor­tional to that of the wind, and the impulſe of the wind is as the ſquare of the relative velocity. Therefore, in order to increaſe the relative velocity by an increaſe of ſail only, we muſt make this increaſe of ſail in the du­plicate proportion of the increaſe of velocity.

Let us, in the next place, conſider the motion of a ſhip whole ſails ſtand oblique to the keel.

The conſtruction for this purpoſe differs a little from the former, becauſe, when the ſails are trimmed to any oblique poſition DCB (fig. 5 and 6.), there muſt be a deviation from the direction of the keel, or a leeway BC*b*. Call this *X.* Let CF be the velocity of the ſhip. Draw, as before, E*g* perpendicular to the yard, and FG perpendicular to E*g*; alſo draw FH perpendicu­lar to the yard: then, as before, EG, which is in the ſubduplicate ratio of the impulſe on the ſail, is equal to Eg — Gy. Now Eg is, as before, = V × ſin. *a,* and G*g* is equal to FH, which is = CF × ſin. FCH, or *— v ×* ſin. (b+x). Therefore we have the impulſe = n S (V ∙ ſin. *a—v* ∙ ſin. (b+x))2.

This expreſſion of the impulſe is perfectly ſimilar to that in the former caſe, its only difference conſiſting in the ſubductive part, which is here *v* × ſin. *b* + *x* inſtead of *v.* But it expreſſes the ſame thing as before, viz. the diminution of the impulſe. The impulſe being rec­koned ſolely in the direction perpendicular to the ſail,