**For the ſimilar particles P** and *p* contain quantities of matter which are as the cubes of their lineal dimenſions, that is, as L3 to Z3. And becauſe the particles are ſimilarly ſituated, R2 is to r 2 as L2 to Z 2. Therefore **P ∙ R 2 :** *p ∙ r2 —* L5 : l5. Now F is to *f* as L2 to l2. For the ſurfaces of the ſimilar rudders or ſails are as thc ſquares of their lineal dimenſions, that is, as L2 to l2. And, laſtly, G*q* is to *gq* as L to Z, and therefore F *∙* Gq : f *∙* gq = L3 : l3. Therefore we have T2 :

∕P∙R2 S*p∙r2* L5l5

***t2 =* : Sp***∙r2* **= τ-3 : 7T= L2 : l2, and T:**

F∙Gq f∙gq

t = L : l.

Therefore the times of performing ſimilar evolutions with ſimilar ſhips are proportional to the lengths of the ſhips when both are ſailing equally faſt; and ſince the evolutions are ſimilar, and the forces vary ſimilarly in their different parts, what is here demonstrated of the ſmalleſt incipient evolutions is true of the whole. They therefore not only deſcribe equal angles of revolution, but alſo ſimilar curves.

A ſmall ſhip, therefore, works in leſs time and in leſs room than a great ſhip, and this in the proportion of its length. This is a great advantage in all cafes, particularly in wearing, in order to ſail on the other tack cloſe-hauled. In this cafe ſhe will always be to windward and ahead of the large ſhip, when both are got on the other tack. It would appear at firſt fight that the large ſhip will have the advantage in tacking. Indeed the large ſhip is farther to windward when again trimmed on the other tack than the ſmall ſhip when ſhe is juſt trimmed on the other tack. But this happened be­fore the large ſhip had completed her evolution, and the ſmall ſhip, in the mean time, has been going forward on the other tack, and going to windward. She will therefore be before the large ſhip’s beam, and perhaps as far to windward.

We have ſeen that the velocity of rotation is propor­tional, *coeteris paribus,* to F × G*q.* F means the abſolute impulſe on the rudder or ſail, and is always per­pendicular to its ſurface. This abſolute impulſe on a ſail depends on the obliquity of the wind to its ſurface. The uſual theory ſays, that it is as the ſquare of the ſine of incidence: but we find this not true. We muſt content ourſelves with expreſſing it by ſome as yet un­known function φ of the angle of incidence *a,* and call it φ**a**; and if S be the ſurface of the ſail, and **V** the veloci­ty of the wind, the abſolute impulſe is *nV2*S × φ*a.* This acts (in the caſe of the mizen-topſail, fig. 10.) by the lever *q*G, which is equal to DG × coſ. DGq, and DGq is equal to the angle of the yard and keel; which angle we formerly called *b.* Therefore its en­ergy in producing a rotation is n**V2**S × φa × DG *×* coſ. *b.* Leaving out the confiant quantities n, **V2,** S, and DG, its energy is proportional to φa *× coſ. b.* In order, therefore, that any ſail may have the greateſt power to produce a rotation round G, it mult be ſo trimmed that *φa* × coſ. *b* may be a maximum. Thus, if we would trim the ſails on the foremaſt, ſo as to pay the ſhip off from the wind right ahead with the greateſt effect, and if we take the experiments of the French academicians as proper meaſures of the oblique impulſes of the wind on the ſail, we will brace up. the yard to an angle of 48 degrees with the keel. The impulſe corre- ponding to 48° is 615*,* and the cosine of 48⁰ is 669.

Theſe give a product of 411435. If we brace the ſail to 54.44, the angle aſſigned by the theory, the effective impulſe is 405274. If we make the angle 45⁰, the impulſe is 408774. It appears then that 48⁰ is preferable to either of the others. But the difference is inconſiderable, as in all caſes of maximum a ſmall deviation from the beſt poſition is not very detrimental. But the difference between the theory and this experimental meaſure will be very great when the impulſes of the wind are of neceſſity very oblique. Thus, in tacking ſhip, as ſoon as the headſails are taken aback, they ſerve to aid the evolution, as is evident: But if we were now to adopt the maxim inculcated by the theory, we ſhould immediately round in the weather-braces, ſo as to increase the impulſe on the ſail, becauſe it is then very ſmall; and although we by this means make yard more ſquare, and therefore diminiſh the rotatory mo­mentum of this impulſe, yet the impulſe is more increaſed (by the theory) than its vertical lever is diminiſhed.— Let us examine this a little more particularly, becauſe it is reckoned one of the niceſt points of ſeamanſhip to aid the ſhip’s coining round by means of the headſails; and experienced seamen differ in their practice in this manœuvre. Suppoſe the yard braced up to 40⁰, which is as much as can be uſually done, and that the ſail ſhivers (the bowlines are uſually let go when the helm is put down), the ſail immediately takes aback, and in a moment we may ſuppoſe an incidence of 6 degrees. The impulſe correſponding to this is 400 (by experi­ment), and the coſine of 40⁰ is 766. This gives 306400 for the effective impulſe. To proceed according to the theory, we ſhould brace the yard to 70⁰, which would give the wind (now 34⁰ on the weather-bow) an inci­dence of nearly 36⁰, and the ſail an inclination of 20⁰ to the intended motion, which is perpendicular to the keel. For the tangent of 20⁰ is about 1/2 of the tangent of 36⁰. Let us now ſee what effective impulſe the ex­perimental law of oblique impulſions will give for this adjuſtment of the ſails. The experimental impulſe for 36⁰ is 480; the coſine of 70⁰ is 342; the product is 164160, not much exceeding the half of the former. Nay; the impulſe for 36⁰, calculated by the theory, would have been only 346, and the effective impulſe only 118332. And it muſt be farther obſerved, that this theoretical adjuſtment would tend greatly to check the evolution, and in moſt caſes would entirely mar it, by checking the ſhip’s motion ahead, and conſequently the action of the rudder, which is the moſt powerful agent in the evolution; for here would be a great impulſe di­rected almoſt aſtern.

We were juſtifiable, therefore, in ſaying, in the be­ginning of this article, that a ſeaman would frequently find himſelf baffled if he were to work a ſhip according to the rules deduced from M. Bouguer’s work; and we ſee by this inſtance of what importance it is to have the oblique impulſions of fluids ascertained experimentally The practice of the moſt experienced ſeaman is directly the oppoſite to this theoretical maxim, and its ſuccess greatly confirms the uſefulneſs of theſe experiments of the academicians ſo often praiſed by us.

We return again to the general consideration of the F *× qG*

**rotatory motion.** We found the velocity *v — —*

*ſp* r∙ ∙

**It is therefore proportional,** *coeteris paribus,* to *q*G. We have ſeen in what manner g G depends on the poſi-