tion and situation of the sail or rudder when the point G is fixed. But it alſo depends on the position of G. With reſpect to the action of the rudder, it is evident that it is ſo much the more powerful as it is more re­mote from G. The diſtance from G may be increaſed either by moving the rudder farther aft or G farther forward And as it is of the utmoſt importance that a ship anſwer her helm with the greateſt promptitude, those circumſtances have been attended to which diſtinguiſhed fine ſteering ſhips from ſuch as had not this quality; and it is in a great meaſure to be aſcribed to this, that, in the gradual improvement of naval architec­ture, the centre of gravity has been placed far forward. Perhaps the notion of a centre of gravity did not come into the thoughts of the rude builders in early times; but they obſerved that thoſe boats and ſhips ſteered beſt which had their extreme breadth before the middle point, and conſequently the bows not ſo acute as the ſtern. This is ſo contrary to what one would expect, that it attracted attention more forcibly; and, being ſomewhat myſterious, it might prompt to attempts of improvement, by exceeding in this ſingular maxim. We believe that it has been carried as far as is compatible with other eſſential requisites in a ſhip.

We believe that this is the chief circumſtance in what is called the trim of a ſhip; and it were greatly to be wiſhed that the beſt place for the centre of gravi­ty could be accurately aſcertained. A practice pre­vails, which is the oppoſite of what we are now ad­vancing. It is uſual to load a ſhip ſo that her keel is not horizontal, but lower abaft. This is found to im­prove her ſteerage. The reaſon of this is obvious. It increaſes the acting ſurface of the rudder, and allows the water to come at it with much greater freedom and regularity; and it generally diminishes the griping of the ſhip forward, by removing a part of the bows out of the water. It has not always this effect; for the form of the harping aloft is frequently ſuch, that the tendency to gripe is diminiſhed by immerſing more of the bow in the water.

But waving theſe circumſtances, and attending only to the rotatory energy of the rudder, we ſee that it is of advantage to carry the centre of gravity forward. The ſame advantage is gained to the action of the after sails. But, on the other hand, the action of the head ſails is diminiſhed by it; and we may call every sail **a** headſail whoſe centre of gravity is before the centre ot gravity of the ſhip; that is, all the sails hoiſted on the bowſprit and foremaſt, and the ſtayſails hoiſted on the mainmaſt; for the centre of gravity is ſeldom far be­fore the mainmast.

Suppoſe that when the rudder is put into the posi­tion AD (fig. 11.), the centre of gravity could be ſhifted to g, ſo as to increaſe *q*G, and that this is done without increaſing the ſum of the products pr2*.* It is obvious that the velocity of convection will be increaſed in the proportion of *q*G to *qg.* This is very poſſible, by bringing to that ſide of the ſhip parts of her loading which were ſituated at a diſtance from G on the other ſide. Nay, we can make this change in ſuch a manner that Spr2 ſhall even be leſs than it was before, by ta­king care that every thing which we ſhift ſhall be nearer to *g* than it was formerly to G. Suppoſe it all placed in one ſpot *m,* and that *m* is the quantity of matter ſo ſhifted, while M is the quantity of matter in the whole ſhip.

It is only neceſſary that *m ∙ g*G2 ſhall be leſs than the ſum of the products *pr2* correſponding to the matter which has been ſhifted. Now, although the matter which is eaſily moveable is generally very final) in com­panion to the whole matter of the ſhip, and therefore can make but a ſmall change in the place of the centre of gravity, it may frequently be brought from places ſo remote, that it may occaſion a very senſible diminution of the quantity Spr2*,* which expreſſes the whole mo­mentum of inertia.

This explains a practice of the ſeamen in ſmall wher­ries or ſkiffs, who in putting about are accuſtomed to place themselves to leeward of the maſt. They even find that they can aid the quick motions of theſe light boats by the way in which they reft on their two feet, ſometimes leaning all on one loot, and ſometimes on the other. And we have often ſeen this evolution very ſenſibly accelerated in a ſhip of war, by the crew running ſuddenly, as the helm is put down, to the lee-bow. And we have heard it aſſerted by very expert ſeamen, that after all attempts to wear ſhip (alter lying-to in a ſtorm) have failed, they have ſucceeded by the crew collecting themſelves near the weather fore-ſhrouds the moment the helm was put down. It muſt be agreeable to the reflecting ſeaman to ſee this practice ſupported by un­doubted mechanical principles.

It will appear paradoxical to ſay that the evolution may. be accelerated even by an addition of matter to the ſhip; and though it is only a piece of curioſity, our readers may wiſh to be made ſenſible of it. Let *m* be the addition, placed in ſome point *m* lying beyond G from *q.* Let S be the ſpontaneous centre of convection before the addition. Let *v* be the velocity of rotation round *g,* that is, the velocity of a point whoſe diſtance from *g* is I, and let p be the radius vector, or diſtance of a particle from g. We have (Rotation, n⁰ 22.) v =

F ∙ *qg*

— — . But we know (Rotation, n⁰ 23.)

*Sp2* + m ∙ *mg2*

that Spρ2 *— Spr2* + M ∙ G*g2.* Therefore *v* = s

*Spr2 + M* ∙ Gg2 + m ∙ mg2 Let us determine G*g*

Spr2 M + M ∙ Gg2 + m ∙ *mg2*

and *mg* and *qg.*

Let *m*G be called z. Then, by the nature of the

centre of gravity, M + m : M = *Gm : gm — z : gm,* and gm =

M

*gm* = —- z, and *m* ∙ *gm2 = —z2*. In

M+ *m* M + m2

M*m2*

like manner, M ∙ Gg2- — z2. Now *m*M2 +

M *gm*

M*m*2— Mm × M + *m.* Therefore M ∙ Gg2 + *m* ∙ *gm2*

Mm × (M + m)z2, M*m* = —- — z2 = ——- z2. Let *n* be =

M + m2 M + m

— , then MG2 + m ∙ *gm2 =* Mnz2. Alſo Gg =

*M + m*

*nz,* being = ———z. Let qG be called *c*: then

M + n

*qg — c + nz.* Alſo let SG be called *e.*

We have now for the expreſſion of the velocity *ν =* F (c + *nz)* F *c + nz*

Spr2 + Mnz2 or v = F/M  ∙ But

M + nz2