point, there, will be a perfect equilibrium, and the ship will have no tendency to plunge into the water or to rise out of it ; for the whole of the water on the bows, in the direc­tion CV, is equivalent to, and may be resolved into the ac­tion CE, by which the progressive motion is resisted, and the vertical action CD, by which the ship is raised above the water. The force CE must be opposed by an equal force VD, exerted by the wind on the sails, and the force CD is opposed by the weight of the ship. If the mean ef­fort of the sails passes above the point V, the ship’s bow will be pressed into the water; and if it pass below V, her stern will be pressed down. But, by the union of these forces, she will rise and fall with the sea, keeping always in a parallel position. We apprehend that it is of very little moment to attend to the situation of this point. Ex­cept when the ship is right afore the wind, it is a thousand chances to one that the line CV of mean resistance does not pass through any mast ; and the fact is, that the ship cannot be in a state of uniform motion on any other condi­tion but the perfect union of the line of mean action of the sails, and the line of mean action of the resistance. But its place shifts by every change of leeway or of trim ; and it is impossible to keep these lines in one constant point of intersection for a moment, on account of the incessant changes of the surface of the water on which she floats. M. Bouguer’s observations on this point are, however, very ingenious and original.

We conclude this dissertation by describing some of the chief movements or evolutions. What we have said hither­to is intended for the instruction of the artist, by making him sensible of the mechanical procedure. The descrip­tion is rather meant for the amusement of the landsman, enabling him to understand operations that are familiar to the seaman. The latter will perhaps smile at the awkward account given of his business by one who cannot hand, reef, or steer.

*To tack Ship.*

The ship must first be kept full, that is, with a very sen­sible angle of incidence on the sails, and by no means hug­ging the wind. For as the evolution is chiefly performed by the rudder, it is necessary to give the ship a good velocity. When the ship is observed to luff up of herself, that mo­ment is to be catched for beginning the evolution, because she will by her inherent force continue this motion. The helm is then put down. When the officer calls out helm’s a-lee, the fore-sheet, fore-top bowline, jib, and stay-sail sheets forward are let go. The jib is frequently hauled down. Thus the obstacles to the ship’s head coming up to the wind by the action of the rudder are removed. If the mainsail is set, it is not unusual to clue up the weather side, which may be considered as a headsail, because it is before the centre of gravity. The mizen must be hauled out, and even the sail braced to windward. Its power in paying off the stern from the wind conspires with the action of the rudder. It is really an aerial rudder. The sails are imme­diately taken aback. In this state the effect of the mizen- topsail would be to obstruct the movement, by pressing the stern the contrary way to what it did before. It is there­fore either immediately braced about sharp on the other tack, or lowered. Bracing it about evidently tends to pay round the stern from the wind, and thus assist in bringing the head up to the wind. But in this position it checks the progressive motion of the ship, on which the evolution chiefly depends. For a rapid evolution, therefore, it is as well to lower the mizen-topsail. Meantime, the headsails are all aback, and the action of the wind on them tends greatly to pay the ship round. To increase this effect, it is

not unusual to haul the fore-top bowline again. The sails on the mainmast are now almost becalmed ; and therefore when the wind is right a-head, or a little before, the main­

sail is hauled round and braced up sharp on the other tack with all expedition. The staysail sheets are now shifted over to their places for the other tack. The ship is now entirely under the power of the headsails and of the rudder, and their actions conspire to promote the conversion. The ship has acquired an angular motion, and will preserve it, so that now the evolution is secured, and she falls off apace from the wind on the other tack. The farther action of the rudder is therefore unnecessary, and would even be preju­dicial, by causing the ship to fall off too much from the wind before the sails can be shifted and trimmed for sailing on the other tack. It is therefore proper to right the helm when the wind is right a-head, that is, to bring the rudder into the direction of the keel. The ship continues her con­version by her inherent force and the action of the head­sails.

When the ship has fallen off about four points from the wind, the headsails are hauled round, and trimmed sharp on the other tack with all expedition ; and although this oper­ation was begun with the wind four points on the bow, it will be six before the sails are braced up, and therefore the headsails will immediately fill. The after sails have filled already, while the head sails were inactive, therefore im­mediately check the farther falling off from the wind. All sails now draw, for the staysail sheets have been shifted over while they were becalmed or shaking in the wind. The ship now gathers way, and will obey the smallest motion of the helm to bring her close to the wind.

We have here supposed, that during all this operation the ship preserves her progressive motion. She must there­fore have described a curve line, advancing all the way to windward. Fig. 13 is a

representation of this evolution when it is per­

formed in the completest

manner. The ship stand­

ing on the course E *a*,

with the wind blowing in

the direction WF, has her

helm put hard a-lee when

she is in the position A.

She immediately deviates

from her course, and de­

scribing a curve, comes

to the position B, with

the wind blowing in the

direction WF of the yards, and the square-sails now shiver. The mizen topsail is here represented braced sharp on the other tack, by which its tendency to aid the angular motion

(while it checks the progressive motion) is distinctly seen.

he main and foresails are now shivering, and immediately after are taken aback. The effect of this on the headsails is distinctly seen to be favourable to the conversion, by pushing the point F in the direction F *is* but for the same reason it continues to retard the progressive motion. When the ship has attained to the position C, the mainsail is haul­ed round and trimmed for the other tack. The impulse in the direction F*i* still aids the conversion and retards the progressive motion. When the ship has attained a position between C and D, such that the main and mizen topsail yards are in the direction of the wind, there is nothing to counteract the force of the headsails to pay the ship’s head off from the wind. Nay, during the progress of the ship to this intermediate position, if any wind gets at the main or mizen topsails, it acts on their anterior surfaces, and impels the after parts of the ship away from the curve *a b c d,* and thus aids the revolution. We have therefore said, that when once the sails are taken fully aback, and particularly when the wind is brought right ahead, it is scarce possible for the evolution to fail ; as soon therefore as the main topsail (trimmed for the other tack) shivers, we are certain that