in a position AB, which is oblique to the stream *ab.* Now, the force which retains it in this position, and which pre­cisely balances the action of the stream, is certainly exerted in the direction DF; and the lighter would be held in the same manner if the rope were made fast at C amidship, without any dependence on the timberheads at D ; and it would be held in the same position, if, instead of the single rope CF, it were riding by two ropes CG and CH, of which CH is in a direction right ahead, but oblique to the stream, and the other CG is perpendicular to CH or AB. And, drawing DI and DK perpendicular to AB and CG, the strain on the rope CH is to that on the rope CG as CI to CK. The action of the rope in these cases is precisely an­alogous to that of the sail y Y ; and the obliquity of the keel to the direction of the motion, or to the direction of the stream, is analogous to the leeway. All this must be evi­dent to any person accustomed to mechanical disquisitions.

A most important use may be made of this illustration. If an accurate model be made of a ship, and if it be placed in a stream of water, and ridden in this manner by a rope mode fast at any point D of the bow, it will arrange itself in some determined position AB. There will be a certain obliquity to the stream, measured by the angle B*ob,∙* and there will be a corresponding obliquity of the rope, measured by the angle FCB. Let *yC* Y be perpendicular to CF. Then CY will be the position of the yard, or trim of the sails corre­sponding to the leeway bCB. Then, if we shift the rope to a point of the bow distant from D by a small quantity, we shall obtain a new position of the ship, both with respect to the stream and rope ; and in this way may be obtained the relation between the position of the sails and the lee­way, independent of all theory, and susceptible of great ac­curacy ; and this may be done with a variety of models suited to the most usual forms of ships.

In further thinking on this subject, we are persuaded that these experiments, instead of being made on models, may with equal ease be

made on a ship of any

size. Let the ship

ride in a stream at a

mooring D (fig. 3), by

means of a short haw­

ser BCD from her

bow, having a spring

AC on it carried out

from her quarter. She

will swing to her moor­

ings, till she ranges

herself in a certain position AB with respect to the direc­tion *ba* of the stream ; and the direction of the hawser DC will point to some point E of the line of the keel. Now, it is plain to any person acquainted with mechanical disquisi­tions, that the deviation BE6 is precisely the leeway that the ship will make when the average position of the sails is that of the line GEH perpendicular to ED ; at least this will give the leeway which is produced by the sails alone. By heav­ing on the spring, the knot C may be brought into any other position we please ; and for every new position of the knot the ship will take a new position with respect to the stream and to the hawser. And we persist in saying, that more

information will be got by this train of experiments than from any mathematical theory : for all the theories of the impulses of fluids must proceed on physical postulates with respect to the motions of the filaments, which are exceed­ingly conjectural.

And it must now be farther observed, that the substitution which we have made of an oblong parallelopiped for a ship, although well suited to give us clear notions of the subject, is of small use in practice ; for it is next to impossible (even granting the theory of oblique impulsions) to make this sub­stitution. A ship is of a form which is not reducible to equations ; and therefore the action of the water on her bow or broadside can only be had by a most laborious and in­tricate calculation for almost every square foot of its surface.@@1 And this must be different for every ship. But, which is more unlucky, when we have got a parallelopiped which will have the same proportion of direct and lateral resistance for a par­ticular angle of leeway, it will not answer for another lee­way of the same ship ; for when the leeway changes, the figure actually exposed to the action of the water changes also. When the leeway is increased, more of the lee-quarter is acted on by the water, and a part of the weather-bow is now removed from its action. Another parallelopiped must therefore be discovered, whose resistances shall suit this new position of the keel with respect to the real course of the ship.

We therefore beg leave to recommend this train of ex­periments to the notice of the Association for the Improve­ment of Naval Architecture, as a very promising method for ascertaining this important point@@2 And we proceed, in the next place, to ascertain the relation between the velo­city of the ship and that of the wind, modified as they may be by the trim of the sails and the obliquity of the impulse.

Let AB (figs. 4, 5, and 6), represent the horizontal sec­tion of a ship. In place of all the drawing sails, that is, the sails which are really filled, we can always substitute one sail of equal extent, trimmed to the same angle with the keel. This being supposed attached to the yard DCD, let this yard be first of all at right angles to the keel, as represented in fig. 4. Let the

wind blow in the direction WC, and let CE (in the di­rection WC continued) re­present the velocity V of the wind. Let CF be the velo­city *V* of the ship. It must also be in the direction of the ship’s motion, because when the sail is at right angles to the keel, the absolute impulse on the sail is in the direction of the keel, and there is no lateral impulse, and consequent­ly no leeway. Draw EF, and complete the parallelogram CFEe, producing *eC* through the centre of the yard to *w.* Then wC will be the relative or apparent direction of the wind, and Ce or FE will be its apparent or relative velocity. For if the line Ce be carried along CF, keeping always pa­rallel to its first position, and if a particle of air move uni­formly along CE (a fixed line in absolute space) in the same time, this particle will always be found in that point of CE, where it is intersected at that instant by the moving line Ce; so that if Ce were a tube, the particle of air, which

@@@, Bezout's *Court de Mαthem.* vol. v. p. 72, &c.

@@@\* This society was instituted on the 14th of April 1791, in consequence of the patriotic and energetic endeavours of Mr. J. Sewell, a bookseller of Cornhill, who was proprietor of the European Magazine, the coven of which periodical he had for a long time previous to this date, gratuitously devoted to the reception of communications for the improvement of naval architecture. The society consisted of about one hundred and fifty noblemen and gentlemen, and numbered among its members some of the most distinguished men in the kingdom. His late Majesty was the president. The Earls Stanhope, Leicester, and Uxbridge, Lords Radnor and Mulgrave, Sir John Borlase Warren, Sir Joseph Banks, and Sir Charles Middleton, were vice-presidents. Unfortunately its energies were expended in the fu­tile examination of plans, to the neglect of the more sure course for the improvement of an infant science—the investigation of principles. The consequence was, that dissatisfied at the absence of all useful results from their labours, the members gradually ceased to take an in­terest in them, and the society fell to pieces, without, we believe, any formal dissolution. Had the members adopted the suggestions of Professor Robison, and their energies and resources been directed by bis talents and experience, how different might have been the result!