goods and the weights balance each other in the scales by the intervention of a beam or steelyard.

When a ship proceeds steadily in her course, without changing her rate of sailing, or varying the direction of her head, we must in the first place conceive the accumulated impulses of the wind on all her sails as precisely equal and directly opposite to the impulse of the water on her bows. In the next place, because the ship does not change the direction of her keel, she resembles the balanced steelyard, in which the energies of the two weights, which tend to produce rotations in opposite directions, and thus to change the position of the beam, mutually balance each other round the fulcrum ; so the energies of the actions of the wind on the different sails balance the energies of the water on the different parts of the hull.

The seaman has two principal tasks to perform. The first is to keep the ship steadily in that course which will bring her farthest on in the line of her intended voyage. This is frequently very different from that line, and the choice of the best course is sometimes a matter of consider­able difficulty. It is sometimes possible to shape the course precisely along the line of the voyage ; and yet the intel­ligent seaman knows that he will arrive sooner, or with greater safety, at his port, by taking a different course ; because he will gain more by increasing his speed than he loses by increasing the distance. Some principle must di­rect him in the selection of this course. This we must at­tempt to lay before the reader.

Having chosen such a course as he thinks most advan­tageous, he must set such a quantity of sail as the strength of the wind will allow him to carry with safety and effect, and must trim the sails properly, or so adjust their positions to the direction of the wind, that they may have the great­est possible tendency to impel the ship in the line of her course, and to keep her steadily in that direction.

His other task is to produce any deviations which he sees proper from the present course of the ship ; and to produce these in the most certain, the safest, and the most expeditious manner. It is chiefly in this movement that the mechanical nature of a ship comes into view, and it is here that the superior address and resources of an expert seaman is to be perceived.

Under the article Sailing, some notice has been taken of the first task of the seaman, and it was there shown how a ship, after having taken up her anchor and fitted her sails, accelerates her motion, by degrees which continually di­minish, till the increasing resistance of the water becomes precisely equal to the diminished impulse of the wind, and then the motion continues uniformly the same, so long as the wind continues to blow with the same force, and in the same direction.

It is perfectly consonant to experience, that the impulse of fluids is in the duplicate ratio of the relative velocity. Let it be supposed that when water moves one foot per second, its perpendicular pressure or impulse on a square foot is *m* pounds. Then, if it be moving with the velocity V estimated in feet per second, its perpendicular impulse on a surface S, containing any number of square feet, must be *m* SV2.

In like manner, the impulse of air on the same surface Way be represented by *n* SV2 ; and the proportion of the impulse of these two fluids will be that of *m* to *n*. We may express this by the ratio of *q* to 1, making m/n= *q.*

M. Bouguer’s computations and tables are on the suppo­sition that the impulse of sea-water moving one foot per second is twenty-three ounces on a square foot, and that the impulse of the wind is the same when it blows at the rate of twenty-four feet per second. These measures are all French. They by no means agree with the experiments of others ; and what we have already said, when treating of

the Resisttance of Fluids, is enough to show us that no­thing like precise measures can be expected. It was shown, as the result of a rational investigation, and confirmed by the experiments of Buat and others, that the impulsions and resistances at the same surface, with the same obli­quity of incidence, and the same velocity of motion, are different according to the form and situation of the adjoin­ing parts. Thus the total resistance of a thin board is greater than that of a long prism, having this board for its front or bow, &c.

We are greatly at a loss what to give as absolute mea­sures of these impulsions.

1. With respect to water. The experiments of the French academy on a prism two feet broad and deep, and four feet long, indicate a resistance of 0∙973 pounds avoir­dupois to a square foot, moving with the velocity of one foot per second at the surface of still water.

Mr. Buat’s experiments on a square foot wholly immersed in a stream, were as follow :

A square foot as a thin plate l∙8l pounds

Ditto as the front of a box one foot long..l∙42

Ditto as the front of a box three feet long.l∙29

The resistance of sea water is about 1/25 greater.

2. With respect to air the varieties are as great. The

resistance of a square foot to air moving with the velo­city of one foot per second, appears from Mr. Robins’s ex­periments on sixteen square inches to be, on a square foot 0∙001596 pounds.

Chevalier Borda’s on sixteen inches 0·001757

on eighty-one inches 0·002042

Mr. Rouse’s on large surfaces 0∙002291

Precise measures are not to be expected, nor are they ne­cessary in this inquiry. Here we are chiefly interested in their proportions, as they may be varied by their mode of action in the different circumstances of obliquity and velo­city.

We begin by recurring to the fundamental proposition concerning the impulse of fluids, viz. that the absolute pres­sure is always in a direction perpendicular to the impelled surface, whatever may be the direction of the stream of fluid. We must therefore illustrate the doctrine, by al­ways supposing a fiat surface of sail stretched on a yard, which can be braced about in any direction, and giving this sail such a position and such an extent of surface, that the impulse on it may be the same, both as to direction and intensity, with that on the real sails. Thus the considera­tion is greatly simplified. The direction of the impulse is therefore perpendicular to the yard. Its intensity depends on the velocity with which the wind meets the sail, and the obliquity of its stroke. We shall adopt the construc­tions founded on the common doctrine, that the impulse is as the square of the sine of the inclination, because they are simple ; whereas, if we w ere to introduce the values of the oblique impulses, such as they have been observed in the excellent experiments of the Academy of Paris, the constructions would be complicated in the extreme, and we could hardly draw any consequences which would be in­telligible to any but expert mathematicians. The conclu­sions will be erroneous, not in kind but in quantity only ; and we shall point out the necessary corrections, so that the final results will be found not very different from real observation.

If a ship were a round cylindrical body like a flat tub, floating on its bottom, and fitted with a mast and sail in the centre, she would always sail in a direction perpendi­cular to the yard. This is evident. But she is an oblong body, and may be compared to a chest, whose length greatly exceeds its breadth. She is so shaped, that a moderate force will push her through the water with the head or stern foremost ; but it requires a very great force to push her sideways with the same velocity. A fine sailing ship of