



# LXI. On the theory of a new species of locomotive vessel that will diminish the ordinary resistance of the water to one-fortieth part of its retarding power in vessels of the same burthen

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stals. This, although an unnecessary complication, would not be of very material consequence were the form to occur only in a simple or isolated state; but as it occurs far more generally in combination with oblique rhombic prisms or pyramids, the anomaly arises, that either the rhomboidal or the rhombic form becomes unavoidably placed in an incorrect position. The harmony, so to say, existing amongst the individual forms of the same crystallographic group is thus destroyed, without the substitution of any real advantage. The employment, therefore, of right rhomboidal prisms is undoubtedly objectionable.

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LXI. *On the Theory of a new species of Locomotive Vessel that will diminish the ordinary resistance of the Water to one-fortieth part of its retarding power in Vessels of the same burthen.* By GEORGE WALKER, Esq., of Port Louis, France. Communicated by Sir GEORGE CAYLEY, Bart.

[With a Plate.]

GENERAL prejudice and even engineering incredulity, not many years ago, denied the possibility of vessels being propelled, unless we had the two elements of air and water to act against each other; and also affirmed, that turning the wheels of railway vehicles by steam power could never give them any useful impulse.

Now the sea is kept in continued foam by the swift prows of its tens of thousands of steam-boats; and the land, of almost every nation, is begirt with its iron roads in every possible direction; and monster-trains are every day conveying their thousands at forty and fifty miles an hour. The incredulity is forgotten; and the parties so forgetting it are quite as ready to avail themselves of these wonderful and most useful practical advantages, as if they had never disbelieved in their possibility, or opposed their nascent progress. Such, however, is the history of human invention: at every new step, first discovered by science, and then attempted to be realized by art, the same incredulity and the same opposition has to be met; but after so many practical lessons on the determined march of scientific engineering in the present age, it behoves us to examine, with competent eyes, and to be more cautious, before we reject projects that startle our present ideas of what is practicable, especially when they involve, *if possible*, an enormous field of *utility*.

The present announcement is of this class; and its theoretical basis is all that is intended to be set forth in this communication.

If the theory be sound, it will not be so in vain ; and however difficult, and perhaps remote its application may be, yet human ingenuity at length overcomes mere practical difficulties, and realizes the use of every great general principle in Nature, at their appointed time, to meet the extended wants of advancing civilization.

The ocean, bearing its heavy burdens from any one shore to every other by wind and tide, and lately by steam, has hitherto been the great means both of civilization and wealth ; but the resistance of water to vessels increasing in the enormous ratio of the squares of their velocities, has placed a limit to steam-boat speed, which can only be exceeded by an unremunerative expense of steam power : and even this is not by any means the limit of the barrier that has to be overcome ; for every increase of speed in the vessel requires an equal increase of swiftness in the paddles to overtake it, which causes the steam power expended to be in the ratio of the cubes of the velocities of the vessel. Thus double the speed requires eight times the power, and three times the speed requires twenty-seven times the power. There is no principle in nature yet known to modify this rapidly accumulating law of resistance, but that of increasing the magnitude of our vessels to as great an extent as their materials will safely permit ; for the resistances will vary as the surfaces of the prows of the vessels, and these are as the squares of any homologous dimensions ; whereas the engine power any vessel can carry is as its solid contents, and these are as the cubes of such homologous parts : hence if any vessel be double the size of another, its resistance will be only fourfold greater at any given velocity, but its floatage to carry engine power will be eightfold.

We have here all the elements of steam-boat navigation as it now stands ; and it seems probable that from eighteen to twenty miles per hour, at great cost, may be a tolerably approximate limit of speed, under every advantage our knowledge of engine power and ship-building materials can command ; and a most astonishing triumph of mechanical skill over natural impediments it is to have attained to this speed.

The law of resistance in water is the great obstacle that causes this enormous consumption of power ; and if it can be shown that there exists in nature a mechanical principle capable of reducing this expense to one-fortieth part of its present scale, its physical and moral value need scarcely be pointed out ; it would extend our railroad speed over the ocean without the cost of its iron way, and this in every possible direction within the command of a sea-girt world. Who can scan the future results of such an increased power of com-

munication between the distant races of men? Let us not, however, consider these advantages as yet within our grasp: it will be quite sufficient if the demonstration here offered of this new principle have no lurking fallacy within it: to all appearance the result seems as undeniable as that of any other mathematical demonstration when applied to mechanical power.

It has been ascertained, by the careful and satisfactory experiments of the French Academy, that the resistance to oblique surfaces moving through water by no means varies in the duplicate ratio of the sines of the angles of incidence, as has been theoretically supposed.

Fifteen boxes were made, two feet wide, two feet deep, and four feet long: one of them was a parallelopiped of these dimensions; the others had prows of a wedge form, the angle varying by  $12^\circ$  from  $12^\circ$  to  $180^\circ$ , so that the angle of incidence increased by  $6^\circ$  from one to another. When the prow was at an angle of  $12^\circ$ , and the angle of incidence  $6^\circ$ , as shown at Plate IV. fig. 3, the resistance was as 3.999 to 10.000 on the base or front surface of the parallelopiped, say practically as 4 to 10.

By the same authority, the resistance to one square foot, French measure, moving with the velocity of 2.56 feet per second, was very nearly 7.625 pounds French. The resistances increased very correctly as the squares of the velocities; and reducing these to English measures, a square foot moving perpendicular to itself in river water, receives one pound resistance when moving with a velocity of 1.01, say 1 foot, per second.

Let AB, fig. 1, be a plane moving perpendicular to itself in water from A to H, and let the velocity be represented by the line AH: the resistance to AB will be as  $AB \times AH^2$ . If the plane AB move towards E, parallel to itself, with a velocity  $Ah = AH$ , the resistance to its perpendicular section AH will be expressed by  $\frac{AH}{AB}$ . But experiment has proved that the

resistance to AB is  $\frac{2}{5}$  of that to its perpendicular AH, viz.  $\frac{2AH}{5AB}$ .

If AB move to E with the velocity AE, the resistance will be  $\frac{2AH}{5AB} \times AE^2$ ; and the power required to overcome this resistance of AB towards H, as  $\frac{2AH}{5AB} \times AE^2 \times AE$  is to  $AB \times AH^2 \times AH$ .

Let the plane AB be ten feet long by one broad, and let the distance from A to H be one foot; then if it be depressed,  
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FIG. 1.

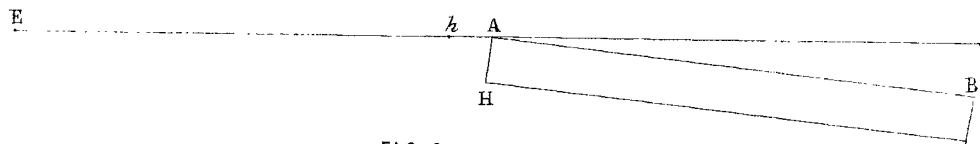


FIG. 2.

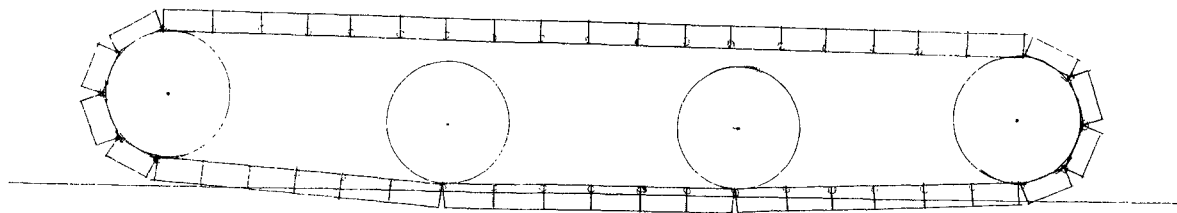
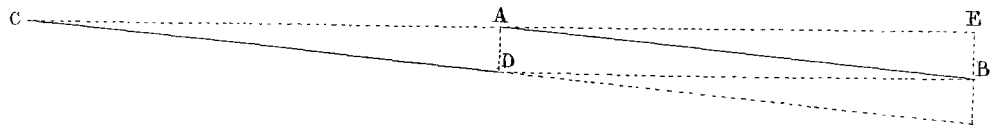


FIG. 3.



FIG. 4.



so as to arrive at H in one second, according to the experiments quoted, the resistance will be ten pounds.

If it move in the direction AE, as before, and AH be one-tenth part of radius, the resistance to the section AH will be one-tenth of that of AB in its motion towards H; and if AB move towards E, the resistance to it will be  $\left(\frac{4}{10}\right)^2 \frac{2}{5}$  of what it was against AH, viz.  $1 \times \frac{2}{5} = \frac{2}{5}$ .

If AB be moved with the velocity AE=10AH, the resistance will be

$$10 \times 10 \times \frac{2}{5} = \frac{200}{5} = 40;$$

and therefore the power to move AB with the velocity AE will be  $40 \times 10 = 400$ ; that is, forty times the power required to move AB to H. Q. E. D.

It is not intended in the present communication to enter upon the various methods that have occurred for carrying out this principle of evading the direct resistance of water, by making the whole displacement of it perpendicular, or nearly so, to the line of the vessel's path; but to render the idea more palpable and distinct, conceive a succession of hollow floats connected together by hinges into an endless chain passing round drums at each end of a frame (see fig. 2), and the lower line floating on the water, and kept, by the nature of the joints, from bending upwards between the drums, aided, if necessary, by intermediate ones. If the drums are made to revolve by steam power or otherwise, new floats are laid down in front, and others are taken up behind in continued succession; and the act is like that of a continue railway over boats. Each float is placed in the water and taken out again without changing its position horizontally; and this, not immediately under each drum, but with the moderate velocity due to an inclined plane; being kept above the water at each end like the prow and stern of a gondola. To gain sufficient buoyancy, a much longer line of floats, depressed by an intermediate succession of drums, may be required; but such considerations form no part of the present essay. It is necessary, however, to observe that the floats have hitherto been only considered as respects the resistance of their lower surface against the water as a plane of certain dimensions moving with a given velocity: these floats will, however, require considerable force to depress them and displace their bulk of water; but being depressed and withdrawn by a slow action, very nearly all the force absorbed by the immersion will be restored by their own buoyant action in emerging; so that this small loss of power

need scarcely be taken into consideration as any set-off against a principle promising a gain of forty to one.

The following additional demonstration of this principle having been submitted to Mr. Walker, he requested that it may be added as corroborative of his views.

If the French experiment of the wedge form, represented by fig. 3, were made only one foot deep, by two feet wide at the base, that half of the prow below the centre line would correctly represent the plane AB, fig. 4; and if both were moved horizontally with the velocity of ten feet per second, as from AB to CD, the plane AB would just meet half the resistance of the prow.

Experiment has shown that the two square feet of base to the prow would, if the prow were absent, at that velocity receive 100 pounds resistance each, = 200 pounds; and that, with the prow, the resistance would be  $\frac{4}{10}$ ths of this, or 80 pounds. Thus one-half, or 40 pounds, would be the horizontal resistance of the plane AB, moving ten feet per second, which is equivalent to 400 pounds moved one foot per second.

As the resistance varies as the squares of the velocities, if the plane AB were placed horizontally, as represented by AE, and then depressed in one second to DB (being one foot), each of the ten square feet would only receive one pound of resistance, and the whole would be ten pounds moved one foot per second, which is just one-fortieth part of the power required in the former case. Q. E. D. G. C.

November 4, 1850.

LXII. *On the Untenableness of the received Theory of Newton's Rings.* By E. WILDE\*.

A DESIRE to investigate the colours of thin plates more closely induced me to have an instrument prepared, by which I am enabled actually to measure the diameters of the coloured rings of Newton to the ten-thousandth part of an English inch, and to attain by estimation an accuracy of one hundred-thousandth of an inch; the same instrument determines the approximation of the glasses to the millionth of an inch. It is therefore capable of a greater degree of exactness than even the spherometer of Biot. I will name it a gyreidometer.

Some years ago an instrument for the exhibition of Newton's rings was invented by Jericau in Sweden; it was named a gyreidoscope by its inventor. The instrument however

\* Translated from Poggendorff's *Annalen*, vol. lxxx. p. 407, July 1850.