1840-9-11, Screw propellers, ***Liverpool Mercury***

Friday, September 11, 1840

Paddle Wheel versus Screw.—Trial of Strength

We have recently had occasion to make favourable mention of Mr. Smith's Patent Screw Propeller, and have had great pleasure in copying the accounts published by the proprietor and his friends, recording the result of their experiments, which appeared very satisfactorily to establish the important fact that vessels of the ordinary construction, and of any tonnage, might be impelled forwards by an apparatus which is extremely simple, and much less bulky and unsightly than the ordinary paddle boxes. On the principle "audi alleram partem" we have now to record an experiment, the result of which is rather at variance with the recently recorded exploits of the Archimedes. We shall first transcribe the report from the *Nautical Magazine* for the .present month, and shall afterwards briefly assign our reasons for not regarding this experiment as by any means decisive of the superiority of the paddle wheel to the screw propeller.

A few days ago the following experiment was made in the river to test the power of the Archimedean screw; as compared with the common paddle wheel, in presence of Mr. Fawcet, the eminent steam-engine builder of Liverpool, Mr. Barnes, and other gentlemen. The Archimedes, with Mr. Smith's screw propeller, and the William Gunston, tug-boat, with common paddles, were lashed together, stern to stern, but with an interval between them of from twenty to thirty feet. The former vesssl has two engines of 5-horse power each, the latter two of twenty.

The Archimedes was employed to tow the William Gunston with her engines and paddle wheels in a state of rest, and this she did with ease; the object of making this preliminary trial being to ascertain that the working efficiency of the screw was not impaired by the relative position of the two vessels. The steam was then let on to the engines of the William Gunston, and a fair trial of strength commenced between them. In a little while the Archimedes was seen to have lost all power over her rival; a minute or two more and the William Gunston was tugging the Archimedes after her in spite of the superior engine power employed on the opposite direction, and in spite also of the aid of her much-lauded screw propeller—at first slowly, and as it were intermittingly, but at a constantly increasing rate of speed, till at last it reached the usual tug-boat speed of from eight to nine knots per hour.

"So complete and convincing an experiment as recorded in the above extract from the Mechanics' Magazine, (vol. 32, p. 149, No. 885 for July,) must indeed have been a most, interesting sight; the result of which has fully confirmed our opinion of Mr. Smith's invention, as being one of those that are theoretically most ingenious, but in practice deficient In the midst of the laudatory accounts of the doings of the Archimedes, which followed her all round the coast like so many wonderful tails, (that is, tales,) we briefly recorded our opinion among our "Shakings," and that too in spite ot her beating an old Government steamer at Liverpool. We ask, then, where is the power of the Archimedes to contend with the ocean wave? and "echo answers - where!" Let her keep to still water, and Mr. Smith's propeller will prove as good in practice as it is in theory. We understand it is being adopted on canals."

We have already observed that we do not regard this experiment as conclusive evidence of the superiority of paddle wheels over the screw propeller, because it ought to be borne in mind that the former have been gradually brought to their present state of comparative perfection by a long series of experiments. Many patents have been obtained for improvements for obviating what is termed the back water, and the paddle wheels in their present state are infinitely superior to those in use in the early stage of steam navigation. It is quite otherwise with the screw propeller of Mr. Smith, which may be said to be in its infancy, and it is reasonable to presume that improvements will also be made in its construction and application. It was hardly fair, therefore, to conclude that because the new propellers are not so effective at present as the most improved old paddles, they may not, in process of time, be rendered superior to the best paddles of the present day.

On a former occasion we have stated that the idea of applying the Archimedian screw to the propulsion of vessels on the water was long since conceived, and put to the test of experiment. We recollect that when we were some forty or fifty years younger than we are at this present moment, an experiment with this kind of screw was made on the Liverpool and Leeds canal, but as it was merely worked by hand the power was so limited that the scheme was for the time abandoned as unpromising, if not impracticable. Another attempt was made to render this principle available to the same purposes in the year 1819, as recorded in the *Mercury* in the following paragraph from a Glasgow paper :—

"INGENIOUS INVENTION.—On Monday se'nnight Mr. Bayne exhibited, on the basin of the Caledonian canal, the model of a frigate impelled by the power of the SCREW against wide and tide. Several gentlemen attended to witness the success of the experiment, and were highly gratified by the manner in which this fairy frigate performed her various revolutions. The simplicity of the contrivance has been much admired."—Liverpool Mercury, March 6, 1819.

As the fact is not stated in this paragraph, we have no means of ascertaining whether steam was used in this experiment, or whether the machinery was put in motion by springs or other agents.

Several eminent scientific men have expressed themselves satisfied of the great importance of Mr. Smith's screw propeller, whilst some of our contemporaries have, in our opinion, sons ewhat prematurely, given it the decided preference to paddle wheels. We transcribe the following paragraph on the subject from the *Scotsman*:--

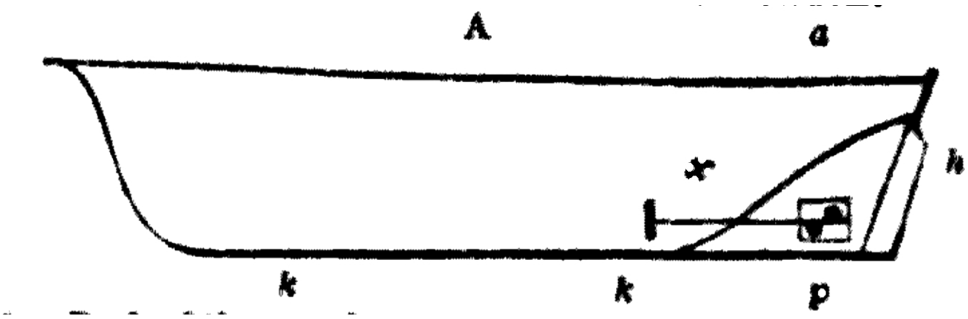
"We have great partiality for this invention, and for a reason which we shall state. Some years ago the idea of impelling ships by a screw, placed like this under the stern, occurred to ourselves. We had a small model constructed, but after making the necessary calculations, we came to the conclusion that the waste of power by the friction of the plates in the water would be so great as to render it of little use. Mr. Smith has shown that this was a mistake. We may mention another result to which our inquiries and observations led us. We were satisfied that a hollow screw would produce much less friction than one in which the plates are joined to a solid axis; that a plate of iron, for instance, two feet broad, twisted into a spiral of eight feet diameter, leaving an opening of four feet in the middle, would encounter less resistance in its rotation than one of six feet, in which the plates continued solid to the axis. This depends on the more complex and unequivocal curvature of the solid than of the hollow spiral. But spokes, or arms, connecting the circular rim with the axis, would also produce much resistance, and our idea was that the most advantageous plan, if it were practicable, would be to attach the plate to the axis only at the two ends, and make the rim of such strength that it would keep its form by the stiffness of the materials.'

Having been repeatedly requested to give a fuller description of the Archimedean principle of propulsion than has hitherto appeared in the *Mercury*, we avail ourselves of the present opportunity to lay before our readers the following article, copied from our respectable contemporary, the *Scotsman*. By the aid of the sketch which accompanies the description, we trust that the principle of the invention and its application to navigation will be rendered intelligible.

"We stated in our last that the Archimedes was moved by a screw instead of paddles, and we shall now explain its construction. The screw consists of plates of iron, (not copper,) fixed edgewise on an axis, and bent into a spiral form, the outer rim forming an angle of 40 degrees with the axis. If only one thread were employed, the propeller would require to be eight feet in length at least, to complete the circle and equalize the pressure all round. but by adopting the plan of a double thread, two half threads complete the circle; the distance from plate to plate is diminished one half, anti the whole length of the screw is only five feet. The diameter of the screw is only five feet nine inches, and, compared with the size of the vessel, it seems so small a machine, that without the evidence of actual experiment no one could have believed that it would propel the vessel at nine or ten miles on hour."

"The Archimedes is a very fine vessel, and rigged as a three-masted schooner, with her masts raking; she is also a beautiful model; and having no paddle boxes, she has the appearance of a pleasure yacht. The following are the dimensions:-Length over all, 125 feet; between perpendicular, 107 feet; extreme breadth, 26½ feet; depth of hold, 13 feet; draught of water (average.) 9½ feet; capacity, 239 tons; and power of engine, 80 horses. This vessel made the voyage from Plymouth to Oporto in 70 hours; intelligence was received of her return from Oporto to Plymouth in 88 hours, total out and home 157 hours, the most part of which was performed against strong head winds and a heavy sea: the distance about 800 miles. This is said to be the most successful voyage ever made by a steam vessel, the efficient working power of which has been ascertained not to exceed 65 horses; and, (says the editor of the Sun,) there can no longer be any question as to the superiority of patent screw propellers as compared with paddle wheels.

Section of the Vessel Lengthwise



A a Dcck of the vessel.

k k The keel.

p The propeller in a square opening of the dead wood.

h The helm.

x The axis of the working gear, with which that of the propeller is connected.

This will enable the reader to form an idea of the position of the propeller, and its size in comparison with that of the vessel.

The axis of the propeller unites with the axis of a pinion, to which motion is communicated from the steam-engine by toothed wheels. It passes along the interior bottom of the ship under the cabin, and is about five feet below the level of the water. When the ship uses sails only, and the steam is not needed, the two axes can be disconnected in an instant,and the screw plays away in the water reversely, causing a very trifling resistance to the ship's way. The loss is found to be only half a mile in nine, and this also could be saved in long voyages, by hoisting the propeller

out of the water.

If water consisted, like wood, of immoveable parts, every revolution of the screw would shove the vessel forward eight feet. But the strong pressure of the plates when the screw is in action, causes a certain displacement of the water, which is said to reduce the velocity by one-sixth. When the steam-engine is going at full speed it makes twenty-six revolutions in a minute, and these are increased by the spur wheels and pinions to 138 revolutions in the screw. This would give a velocity of 1104 feet (138 x 8) per minute, or fully twelve miles per hour, if the water suffered no displacement, but the actual velocity is only a little more than ten miles.

The upper figure gives an idea of the size of the propeller compared with the transverse section of the ship; but the water rises to only b b, and to get a just conception of the proportion which the power bears to the resistance, we must compare the propeller with the immersed part of the section AABB only. In an article in the *Liverpool Standard*, we find the area of the immersed part at ten feet draught, stated to be 143 square feet. Now the diameter of the propeller being five feet nine inches, its area, or the surface of water against which it presses, is 26½ square feet; and it follows that the propelling surface as to the area upon which the resistance acts, only as I to 5½. Hence the astonishment which the small size of the propeller excited.

The screw has one defect, that a considerable amount of power must be wasted by the friction of the iron plates in the water, in its very rapid circular motion. But to counterbalance this, it has great advantages;-

1. The propelling machinery saves weight, room, and expense. and is more conveniently placed than under the present system. While the paddle wheels have a weight of many tons, and being far above the level of the water, lessen the ship's stability, the propeller is six times lighter, and is placed entirely below the water where it increases the ship's stability, and occasions no loss of room.

2. The propeller being entirely under the water, will work perfectly in a rough sea, where the paddles would be nearly useless. In ships of war the propeller would be out of the reach of shot, and leave the whole sides of the ship free for mounting guns.

3. The propeller has the vast advantage, that it enable us to combine steam power with sails, in the most perfect manner. In our present steam-boats, when a favourable wind occurs and the sails are spread, the steam in general becomes either useless or mischievous; the one paddle is too deeply immersed in the water to work; the other is fanning the air: and the sudden plunges which the paddles make, particularly in a rough sea, produce a dangerous straining both upon the ship and the machinery. The propeller being fairly in the centre under the stern, the rolling, or the inclined position of the ship never lifts it out of water even in part. When the wind is fair, the steam-engine can be stopped, the propeller thrown out of gear, and left to play away in the water. Fuel may thus be saved, and the steam power preserved- for calms and foul wind. With this invention steam may become what it has never yet been, an excellent auxiliary to sails.

4. Those formidable surges, occasioned by the action of the paddles, which swamp so many boats, and cause the loss of so many lives, are avoided. The propeller merely causes a slight agitation of the water, similar to what is seen in the wake of a sailing vessel, and not greater in amount. Hence its suitable for navigation in such rivers as the Thames, Clyde, and Mersey.

5. By reversing the action of the screw, the ship can move backward as well as forward. Being disencumbered of the bulky projections of the paddles, she can thread her way amidst obstacles which would stop an ordinary steamer; she has the same superiority in laying her side to a quay, or to anther vessel, for the discharge of a cargo; and she can enter locks and canals from which the present vessels are excluded by their great breadth.

6. She obeys the helm more quickly than a sailing vessel—nay, she obeys it even before she moves. Strange as this may seem, it is easily accounted for. The moment the propeller begins to act, a current of water is forced against the helm, and has exactly the same effect as if the ship were under way.

1851, *Civil Eng & Architect's Journal*, screw canal tug boat, Liverpool area

SCREW TUG-BOAT FOR CANALS.

The great obstacle to the employment of steam-tugs for tractive power on canals is, as our readers are well aware, the injury to the banks resulting from the swell or wash thrown off at the bows, or created by the peddles. Numerous inventions, since the introduction, of steam navigation, have been made public, with a view of obviating this difficulty, and securing to canal companies some portion of their former carrying trade which is gradually passing into the hands of railway companies. It certainly is to be regretted that the admirable system of internal communication, to the full development of which the genius of Brindley was applied, and the construction but recently effected, and that at great cost, should be now comparatively useless. The great relief to the trunk lines of railway—such, for instance, as the London and North Western Railway—the system of canals would afford, if steam tractive power could be rendered available for the conveyance of heavy goods and merchandise upon them, renders any suggested mechanical contrivance that is likely to effect this desideratum an object of considerable interest, independently of the increase it would cause, if successful, to individual incomes.

Among the inventions for this purpose that have been lately tried, attention has been directed to a screw steam-tug boat, a model of which was submitted to the members of the Liverpool Polytechnic Institution, at their last monthly meeting, by Mr. Walker, who also explained the principle of its construction as consisting in her having a semicircular tunnel, nearly one-third of her width, running from bow to stern. A spindle, from about midships, is carried with the tunnel or gutter, and supported by a light iron framing, which also supports the heel of the rudder. On three different portions of the spindle sections of a graduated screw are fixed, and their revolution is attained by means of spur-wheels, connected with steam power on board. The working has been tried by a boat 20 feet long, but only at present by hand-power. Two hands made a speed of about 5 miles an hour. The floatage is light, and from the construction, the boat has been found to be very difficult to upset.

1853, ***Mechanics Magazine***, Vol 58. pp471-472

STEAM ON THE LEEDS AND LIVERPOOL CANAL.

We take from the June number of the ***Artizan***, the following account of the trial of the ***Conqueror***, on the Leeds and Liverpool Canal, to which reference is made in another page under the head "Trades of Birmingham." The Editor of the ***Artizan*** observes in a note appended to this description, that an arrangement similar to it has been used for many years on the American canals by Captain Ericsson;

Mr. W. Laird, general manager of the Ince Hall Coal Company, has put himself in communication with the Directors of the Leeds and Liverpool Canal, for the purpose of adapting steam to the present system of boat towing on canals or rivers; and on Saturday an experiment was successfully tried on the above canal. The steamer used on the occasion was the ***Conqueror***, belonging to Mr. Inshaw, of Birmingham, who, with his son, superintended its working.

That portion of the canal on which the trial was made is very favourable for the introduction of steam-haulage—the distance from Wigan to Liverpool being thirty-six miles, with only one lock at Appley, five miles from Wigan, to which it is propose to continue horse-haulage; but from thence to Liverpool, thirty miles of uninterrupted level, to use steam. On Saturday, the ***Conqueror*** towed with ease four loaded coal-boats, containing forty tons each, at the rate of two miles and a half per hour—a speed as high as is required for coal traffic—though she is a passenger boat of only six horses' power, built for lighter work and a greater speed.

The boat is propelled by two screws, one on each side of the rudder; these screws work right and left—a peculiarity of construction first applied to canal steamers by Mr. Inshaw—and thus the surge which each screw of necessity makes is negatived by the action of its fellow. Hence the swell on the banks of the canal did not exceed, even if it reached, that caused by horse-towing.

The practical result of the experiment may be thus stated :—The present cost of haulage of 40 tons of coals by horse power from Wigan to Liverpool is 35s. 6d. or, per ton, 10½d. By steam power the towing-boat would be one of the ordinary canal boats, carrying an engine and boiler of 12-horse power, the weight of which would not exceed five tons, leaving space for stowage of a cargo of coals weighing 35 tons, four boats following, carrying 40 tons each,-160 tons: total, 195 tons. Allowing three days for going to and from the colliery, 36 miles there and 36 miles back, or 72 miles altogether, in as many hours, the boats would make two trips per week, instead of two trips in three weeks, as at present, and would deliver in Liverpool weekly 390 tons. The weekly expenses would be as follow:

Ten per cent. as cost of engine, and fitting same in one of present canal boats, say £300, is per annum £30, or weekly:	£0-12-0
Engineer's wages:	1-10-0
Fireman's wages:	1-0-0
Two steersmen's wages, at 15s.:	1-10-0
Fuel, at rate of one ton, or 5s. per day :	1-10-0
Oil, waste, and repairs:	0-10-0
Expense of hauling by horses, boats, &c., between Wigan and Appleby Lock, six miles, at Is. per mile, or 6s. two journeys	0-12-0
Total weekly expenses:	£7-4-0

incurred in delivery of 390 tons of coal; being equal to the rate of 4$^{3}/_{8}$d. per ton.

The cost of horse haulage per ton being 10½d.

The steam haulage 4½d.

The saving is 6d. per ton.

But this is not the only saving, as Mr. Laird proposed the application of a drum to the engine to make the boat engine discharge, by the assistance of cranes, each of the boat's cargoes into the yards, or into ships at Liverpool, thus effecting a further saving in terminal expenses. The importance to the Ince-Hall Company of possessing a full control over their traffic may be estimated from the following statistics :—The annual vend of coal is between 300,000 and 400,000 tons; and they pay to railway and canal companies for haulage and tolls between £30,000 and £40,000 per annum. They even send coal into Staffordshire for house consumption; while the importers of coal at the seaports in the United States, after paying 30 per cent. duty, find the Ince Hall cannel the cheapest article they can procure for the manufacture of gas. The experiment was considered so far satisfactory, that Mr. Inshaw was desired to place himself and his boat at the disposal of the Directors of the Canal Company, with the view of trying further experiments in the course of the following week.

[An arrangement similar to the above has been used for many years on the American canals by Captain Ericsson.—Ed.]

1853-5-24, Steam on the L&LC, ***Liverpool Mercury***

Frequent and serious delays having arisen in the carriage of coal on the canal from Wigan to Liverpool by the present system of boat-towing by horses, Mr. William Laird, general manager of the Ince Hall Coal and Cannel Company, directed his attention to the subject, with the view of obviating the many disadvantages in connection therewith. Steam as a motive power on canals for passenger traffic has already been repeatedly and advantageously used; and having ascertained the practicability of adapting it to goods traffic, Mr. Laird put himself in communication with the directors of the Leeds and Liverpool Canal, to obtain their sanction to this mode of conveyance. The directors met his suggestion in a friendly spirit, appointed three gentlemen to confer with him, and agreed to subscribe a sum of money towards the cost of the experiment. On Saturday is was tried, in the presence of Mr. Tatham, the secretary, Mr. Stanley, the engineer, and Messrs Birkbeck and Brackley, directors, of the Leeds and Liverpool Canal Company. There were also present Mr. James Darlington, mining engineer of the Ince-hall Company, who, in conjunction with Mr. Laird, conducted the experiment; Mr. Braithwaite Poole, general goods manager of the London and Northwestern Railway Company; Mr. Barton, of the firm of Barton and Winders, coal proprietors, Liverpool; Mr. E. Kegg, agent of the Kirklees Hall Company; Mr. Smith, of the firm of A. Smith and Son, merchants; and Mr. Murray. Invitations had also been sent to the chief colliery proprietors, several of whom attended. The steamer used on this occasion was the ***Conqueror***, belonging to Mr. Inshaw, mechanical engineer, of Birmingham, who, with his son, superintended the working of the vessel. Mr. Inshaw is one of those thoroughly practical men who, without seeking for self-praise, help largely to sustain the superiority of English mechanical skill. He has constructed several steam passenger boats for the Grand Canal in Ireland, as well as for other canals, and in every instance their work has been performed in the most satisfactory manner.

That portion of the canal on which the trial was made is very favourable for the introduction of steam-haulage, the distance from Wigan to Liverpool being 36 miles, with only one lock at Appley, five miles from Wigan, to which it is proposed to continue horse-haulage, but from thence to Liverpool, 30 miles of uninterrupted level, to use steam. On Saturday, the ***Conqueror*** towed with ease four loaded coal boats, containing 40 tons each, at the rate of two miles and a half per hour—a speed as high as is required for coal traffic—though she is a passenger boat of only six-horse power, built for light work and a greater speed. The ***Conqueror*** is propelled by two screws, one on each side of the rudder; these screws work right and left—a peculiarity of construction first applied to canal steamers by Mr. Inshaw—and thus the surge which each screw of necessity makes is negatived by the action of its fellow. Hence the swell on the banks of the canal did not exceed, even if it reached, that caused by horse-towing.

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	£	s	d.
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Fireman’s wages	1	0	0

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Total weekly expenses	£7	4	0

Incurred in delivery of 390 tons of coal, being equal to a rate of 4¾d. pr ton.	
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Of steam haulage:	4½d.
The saving is	6d per ton

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The importance to the Ince Hall Company of possessing a full control over their traffic may be estimated from the following statistics :—Their annual vend of coal is between 300,000 and 400,000 tons; and they pay to railway and canal companies for haulage and toils between £30,000 and £40,000 per annum. They even send coal into Staffordshire for house consumption; while the importers of coal at the seaports in the United States, after paying 30 per cent duty, find the Ince-hall cannel the cheapest article they can procure for the manufacture of gas.

Whether steam-haulage should be in the hands of the Canal Company (in the event of their sanctioning its adoption), or be left to the enterprise of others, is of course a matter for consideration; though uniformity and efficiency of working would probably be more completely ensured under the management a the company, who would thus become the only carriers on the canal. It is possible, too, that the introduction of steam-haulage might lead to the development of a local passenger traffic. at a cheap rate, thus materially increasing the revenue to be derived from the canal. However that may be, the experiment of Saturday was considered so far satisfactory, that Mr. Inshaw was desired to place himself and his boat at the disposal of the directors of the Canal Company, with the view of trying further experiment, in the course of the present week.

1858 *The Engineer*

STEAM ON CANALS.--A company has been formed in Liverpool among the coal proprietors and those interested in the Lancashire coal trade, with the object of bringing coals from Wigan and district to Liverpool by steam power on the canal. One steam tug has been working most successfully on the Leeds and Liverpool Canal for the last twelve months, and the company have now ordered four steam tugs of 12-horse power each, two of which are contracted for by Messrs. Lawrence and Co., of Liverpool, and two by Messrs. Earle and Co., of Hull. The boats are to be fitted with Burch's patent screw, which has been found to answer so efficiently in shallow water. The tugs will be ready early in January.

1859, From TNA, BT41/351/2011.

Leeds & Liverpool Canal Steam Tug Company, formed November 1858, with records of shareholders dating from December 1859. The registered office was at 87 Oldhall Street, Liverpool.

Joseph Burch, (see the ***Engineer*** 1858 above) who owned 20 shares, lived at Wildboarsclough, Macclesfield. James Pickering, a coal agent from Upholland, was Chairman. The other shareholders were mainly coal proprietors and merchants from the Liverpool and Wigan area.