

Gentleman's Magazine January 1796 pp 30-32, 94-95

Observations on the Utility of Small Canals

Mr. URBAN , Jan 1.

As the introduction of Small Canals may be of rational importance, I hope the observations on their formation and utility, in the inclosed paper, will be found worthy of a place in your very useful and entertaining Magazine.

Yours, &c. ROB. FULTON,

This subject has never been publicly investigated, yet one which I conceive a national importance, and worthy the consideration of every friend to improvement.

The country has arrived at a period sensible of the importance of internal navigation. Wherever canals extend, the carriage of materials is lowered, and in an agricultural view they are a most powerful agent, by reducing the expence of transporting the ponderous ingredients of manure.

But, to facilitate their construction, and that they may be extended in every direction, some mode of formation much less expensive than locks must be adopted.

In viewing the operation of a lock, it appears, that, if they were built for small boats, the delay in passing would be so great that an important trade could not be transacted, as it requires almost as much time to pass a small as a larger boat. Hence, to perform any considerable quantity, a lock must be sufficient to admit a boat of at least 20 tons, and such boats demand a wide, deep, and expensive canal, particularly in hilly countries, or where tunnels and aqueducts intervene.

But, to establish a cheap system of navigation, canals must be small, tunnels narrow, land saved, embankments reduced, reservoirs contracted, and small boats introduced. For this purpose, locks must be avoided, an valleys in many instances crossed without aqueducts, contracting the expence on all the parts, yet retaining the power to perform the trade; the principle being to lay the weight, on the canal, in length instead of breadth.

By a small-boat, I mean one of four tons, four feet wide, twenty long, two feet ten inches deep. Such boat, being larger than the chest of a waggon, will contain almost every thing but timber, one horse conveying ten. They will contain lime, limestone, coals, lead, iron ore, grain, flour, iron ware, and pottery of all kinds, and all bodies, ponderous and compact, as well as boats of any size whatever; they will contain hogsheads, boxes, and bale goods, not exceeding four feet in width (which are seldom of greater dimensions). Each boat will receive 15 sacks of hops, cotton, or wool; and although the 15 sacks will not weigh four tons, the same circumstance is attendant on all other boats, it being impossible to give then the weight of tonnage by such materials, yet one horse may take the greater number of boats, to make up his weight.

Considering the articles enumerated, I think there are few things excluded; and the question is, whether a company should expend £100,000 instead of £50,000 to accommodate the few things which these boats cannot convey?

Thus seeing that most things may be navigated in small boats, and small boats contract the expence of a canal, the next thing will be to pass them to and from the different ponds with ease and expedition. For this purpose I have constructed various models, by perpendicular lift and inclined plane, each having for its leading principle a preponderating tub or cistern of water to give the power, and of which perhaps the following is the most simples:

The ponds of canal being run to such points of hills as will give the greatest possible rise at one time, a double inclined plane must be constructed, on which the ropes or chains must perform a rotatory movement; by passing round an horizontal wheel at top and bottom by

the rotatory movement, the descending boats will even pass down one plane, and the ascending mount the other, keeping up a successive instead of an alternate motion. To perform this, the plane must either be composed of rollers, or each boat have four small wheels, placed beneath its bottom, with the axles cased, to prevent resistance in the water.

The reason for the specific formation of the apparatus is, that, as it is necessary to introduce small boats, to have a small canal, it is absolutely necessary such boats should pass quick over the plane, that a quantity of trade may be performed. By composing the plane of rollers, or mounting a boat with wheels, she will be ready for transfer without losing time in fixing her to a carriage for that purpose. And the operation in a descending trade will be thus: the first boat being raised out of the upper pond on the plane, by means of the water tub, and hooked to the chains, the first in descending will draw out the second, the second the third, and so on, to any number of boats; at the same time, raise those that are empty by their descending weight; the whole being performed with the loss of only one ton of water applied to the first boat: hence, in a descending trade, as is frequently the case from collieries and lime-works, all the water in demand is a pond to bring the boats to the plane, where they are passed to the different levels, without the replenish which locks require.

When an alternate or ascending trade is presented, the water-tubs are applied to draw the boats up the plane; and in such case the waste of water is little more than the weight of the respective cargoes.

In passing the boats, there is little more to do than hook them to the chains, the rotatory movement conveying them up and down in regular succession. To entering the different ponds, they discharge themselves from the chains without farther trouble. By this movement, I conceive two four ton boats, one up and one down, may pass a plane, whose perpendicular is 200 feet, in three minutes, which is equal to 1920 tons in 12 hours; those boats mounted on wheels may be considered as so many waggons moving on a fluid to a certain point, then running down or mounting a hill, by an adequate power.

When timber longer than 20 feet is to be transported, it may float in the canal, till arriving at a plane, when it is taken on wheels prepared for the purpose, and passed with little more trouble than a boat. In Russia and America, great quantities of timber are floated to the sea-ports; and the same system, I conceive, may be practised to advantage in canals.

In cases where water can be spared, and a deep valley may require an expensive aqueduct, I propose to erect a stage either parallel or inclined, the chains performing the rotatory movement as before described, with preponderating water-tubs to draw the boats to the different ponds; this operation will be similar to the inclined plane, and at the same time a valley is crossed, height may be gained where the ground admits of such advantage. In constructing these machines, it appears that a plane to mount 100 feet may be executed for £2,500 taking the average of situations; while locks for 25 tons boats, to the same height, is usually estimated at £7,000. In an aqueduct now building, estimated at £15,000 an engine, as has been described, might be erected for £4,000, which leaves £550 per annum, from which deduct the wages of two men, with wear and care, £120 and the annual savings will be £430; these calculations will give some idea of the manner in which the savings are produced.

On a canal formed for four-ton boats, boats three feet wide, containing three tons, will work to great advantage in collieries or lime works, as they will move through narrow and cheap tunnels; yet, where it may be inconvenient to form a tunnel, such boats may be conveyed by a rail-way to the pits, there take in their cargo, and, descending to the canal,

be immediately ready for navigation. This mode will save the expence of first loading into waggons and then into boats; also avoid the breakage of coals.

In the course of a voyage, where three or four tons of coals are in demand, one or two boats may be left without detaining the boatman, which the purchaser may discharge in his return: but, in a 25 ton boat, the whole must be detained till the quantity purchased is delivered.

Having, I hope, exhibited many conveniences attendant on small boats, must next be considered which are the situations proper for their application; and this may be brought under three heads.

First, All independent canals, such as are formed without entering the ocean, rivers; or larger canals, in all such cases the principal may easily be established, and the succeeding branches extended by the same system.

Secondly. In all cases where cargoes are transferred from larger to smaller craft, such as from coasting vessels, or 40 tons boats, to those of 25 tons; for, if the cargo is transferred, it may as well be to a 4 tons boat, which boat will navigate a canal constructed for half the sum requisite to one of 25 tons.

Thirdly, it is worthy of consideration, whether it is not better to form long lines of canal for 4 tons boats, and transfer the cargo, than enter into the enormous expence of a navigation for boats of 40 tons.

Hitherto it has been a prevailing opinion (and many long canals are forming on the principle), that the canal should be of a width to admit the coasting vessels, to avoid the expence of transferring the cargoes to small boats.

While there was no alternative but 40 or 25 tons boats this system may hold good, as the difference in expence was not of such great importance. But, on taking a comparative view of a canal for 40 and 4 tons boats, the great saving by adopting the latter renders the object of loading and unloading at the coast trifling.

For, wherever a canal is to be constructed for 40 tons boats, one-third the sum would execute one for boats of 4 tons. Therefore, when I look to a company who are spending £300,000 where £100,000 would answer the purpose, £10,000 per annum is left to pay for transferring cargoes; which, at 3d, per ton, allowing 280 working days per year, would pay for re-loading 2857 tons per year. Thus it appears a principal is sunk to save a transfer, of which there is not the most distant prospect. Few canals have a prospect of a trade which would require a transfer of 500 tons per day, which, at 3d, per ton, would amount to £1,700 per annum; yet, to avoid this, £10,000 per annum is sunk, which, admitting that the expence of transfer falls on the proprietors, makes a difference of £8,300 per annum in favour of the small coal. Yet I do not conceive that the expence of transferring the cargoes will fall on the company, but bear on the freighter; and the question is, whether the freighter will be deterred from sending his goods by the canal in consequence of the additional 3d. per ton? If so, he must have an admirable alternative, much superior to land-carriage; and in such case the company can lower the tonnage to favour the freighter, yet have better prospect of emolument by the small than they possibly can by the large canal, in consequence of constructing it for one-third the sum.

Hence I conclude the coasting trade will be conveyed as much by the small as the larger canal.

While all goods taken in at any point of the canal, and delivered on its banks, will be the same in loading into large as small boats; yet, in coals, stone, or minerals, the small boats will have as advantage by taking in their cargo at the delphs, or works.

Thus it appears proprietors have as good a chance of receiving 15 per cent, by the small as five by the larger work; yet, guarded against any material loss, they have every advantage which a large one can give.

In connexions with larger canals it may be stated, that small canals exclude large boats; but large canals will nor exclude small boats; a nest of small boats will pass a lock, and navigate to a defined point, wherever canals extend, without moving the cargo. Hence I conceive there are few situations but the small canals are preferable, particularly in long lines, such as communications between the English and Bristol channels, or Solway Firth to Newcastle or Sunderland, with junction of distant canals. But the situations to which they are applicable will be easily determined by comparing the saving of principal with the transfer of cargo, keeping this in view, that the transfer of cargo will seldom fall on the canal proprietors.

It is pretty generally allowed, that canals benefit a country whatever may be the fate of the subscribers. But this principle will give subscribers a better chance; and they, feeling an interest, will be encouraged to extend their speculation. When I consider that, instead of a canal 30 miles long, a company may have 90 miles for the same money, and each part competent to the trade, the disparity certainly is great - in a double senses; first, as emolument to the company - second, as a benefit to the country. In a national and agricultural view, I see them of the greatest importance, by reducing the number of horses, and rendering cheap the articles of fuel and manure, Wherever they extend, their trifling expence invites connexion; skirting the hills, they spread a verdure on the barren heath, and warm the cottage of the helpless poor.

During my thoughts on this subject, I have exhibited the principle to some committees, who have become sensible of its utility too late, part of their canal being finished, or the parliamentary line not admitting of deviation sufficient to apply the planes to advantage. Therefore, as the system should be kept in view from the first survey, I have thought proper to give my ideas through the medium of Mr. Urban's Miscellany for the following reasons :

1. If the principle is a good one, it should be generally known.
2. If it is not, I shall be infinitely obliged to any one who will exhibit its insufficiency.
3. That companies who have canals in contemplation may weigh the subject.
4. That every argument for and against may be brought before the pubick.

And for this purpose, without wishing to impose a talk on any one, I think myself justified in calling, on gentlemen engineers, particularly Messrs. Jessop, Whitworth, Outrim, Milne, and Rennie (whole merits I esteem), to state their objections to this system of navigation; which I, here promise publicly to acknowledge, or confute, from the observations I have made: their science I shall consider as a tacit acknowledgement of its superiority. I shall also be obliged to any other gentleman for their thoughts either for or against the small boats, machinery, and system of conveyance.

ROBERT FULTON.