

The cause of the obstruction of the harbour's mouth appears to me to be this : The whole coast, which stretches away northerly, is apparently for miles a flat and sandy shore, and I suppose from the harbour of Aberdeen till it meets with the point of Buchanefs, (which is at the distance of seven leagues), continues of the same kind ; consequently the wind at N. E. acting obliquely upon it, brings the sands and gravel intermixed coastwise towards the south ; and as the coast from the south side of the entry of this harbour stretches away nearly east for about three quarters of a mile, those sands would naturally be deposited in the angle of the coast formed at the harbour's mouth, did not the land waters of the river Dee, in finding a passage to sea, force themselves a vent, which they maintain more or less clear according as the circumstance of winds, tides, and freshes, balance one against another. A hard gale of wind at N. E. as already mentioned, gradually brings the sands and gravel coastwise southward, and puts in agitation that already lodged in the bank on the north side of the harbour's mouth, at the same time forcing it into the entry, and if at that time it happens to be spring tides and little fresh water in the river, a strong tide of flood being the consequence, greatly co-operates with the wind and seas in carrying a large quantity of sand and gravel into the channel of the river ; and the fresh water in the river being supposed then very short, the reflux will be very languid, and being counteracted by the impetus of the sea, it cannot return ; and a continuance of weather and circumstances of this kind, will put the mouth of the harbour into the worst state, in which it must necessarily remain till by a contrary disposition of circumstances a contrary effect is produced. On the other hand, a continuance of great land floods, either at spring or neap tides, accompanied either with off shore winds or moderate ones at N. E. gives the greatest advantage in scouring away the sands and gravel from about the harbour's mouth, carrying it out into the road, from whence by degrees it gets round the point of *Girdlenefs* ; and if towards the close of the work there happen along with a strong land fresh, low spring ebbs, which give the current the greatest fall to sea, and at the same time run bare over the bar with a moderate wind at N. E. which will give the sand some agitation without much impetus ; under these circumstances, the stony body of the bar will be cleared of sand, and the harbour's mouth be put in its best state, and so will remain till the contrary causes produce as before the contrary effects : and in this state of fluctuation must the entry of the harbour of Aberdeen ever remain, till something is done to counteract the effects of that arrangement of circumstances whose natural tendency is to do harm.

The only means by which I can see that this is likely to be effected, is the erection of a north pier, as shewn at N. N. in the plan, which will directly tend to the cure of the evil

evil complained of; for it will not only keep the land freshes more confined in a body till they come into deeper water, but what is of more consequence, will in a great measure prevent the sand and gravel from being driven in. It will not indeed stop the continual driving of the matter coastwise from the north, but after the back or outside of the pier is filled up with sand, &c. to a certain degree, it will then go round the pier head, and by the superior action of middling freshes and spring ebbs will be kept in deeper water, and so get round the point of Girdlenefs, without getting into the harbour's mouth, or at least not in such a degree as to obstruct the navigation. By this means, as the bar will not only be kept clean down to the stone bed, but by lifting the larger sort of stones by art, the remaining gravel will wash out into deeper water, so as to make (as may reasonably be expected) full two feet more water than there now is in its best state.

I can see no objection to the putting of this work into immediate execution, save the expense of it. To reduce this as much possible, I have endeavoured to propose such a construction, as, consistently with that solidity and permanency which a work of this kind ought to have, consists of the smallest quantity of materials and workmanship that I can think sufficient; and as the materials which nature furnishes here are of the best kind for the purpose, and are found near the place, I am in hopes that they will be raised and put together considerably cheaper, than I have supposed in my estimate, which for that reason I desire may be considered in no other light than a form or blank, comprehending species and quantities: for as my stay at Aberdeen was necessarily short, the requisite examinations immediately relating to the harbour prevented my entering into those enquiries, which tended only to acquaint me with the price and value of labour and materials. I therefore can only fill up the blanks by comparison with what has been done at other places less advantageously situated with respect to materials, and perhaps that of labour also: in order therefore to come at a real estimate suited to the place, I must beg leave to refer myself to the enquiries of the magistrates concerning prices, or to a committee deputed by them for that purpose; and which, from their particular knowledge of the country and of the workmen, will I apprehend be done to more advantage than I could have done myself, without a longer stay than my other avocations could possibly admit of.

One thing, however, I must beg leave to suggest, that though what I now offer is as I apprehend the complete thing, which I expect to answer in the best manner, yet I am of opinion that it will be found if the pier be not carried out so far by 200 feet, that it will in a great measure relieve the present annoyances, nay, that it will be of singular service if carried out but just beyond the present pier, on the south side of the entry, in which case it will be shortened by 350 feet. In the former case the expense will be reduced according

according to my estimate by £2,028, and in the latter by £3,549; and as the work ought to be begun from Sandnesh Point, where it is easiest and cheapest to be done, the workmen will gradually learn the way of doing it to the best advantage, and will probably be able to contract for the more expensive part, upon better terms than would seem to them feasible at the beginning; and as the work advances, the benefit and effect will be seen, so that it needs not to be carried further than by experience shall be proved necessary.

I come now to the improvements that may be made in the internal part of the harbour. Here I cannot but lament that the course of the river is distracted by so many channels, and covers so great a breadth of ground at high water, which want of confinement is not only detrimental to the procuring of a deep channel at the harbour's mouth, but within the harbour also, and it is particularly disadvantageous that the main current of the river does not sweep the face of the town's key at L: this I should without any hesitation advise to be done by art, were it not for the fishing properties upon the main channel; but, as I must suppose them irrevocably established, it remains to point out what is the best that can now be done, the fishings remaining as they are. I observe that within the Point of Sandnesh there is nearly the same water as over the bar, till the main river channel and navigation channel divide, which part of the river is marked in the plan as the *Stell Fishing*. In this part of the river, which is land-locked from all winds, vessels that will bear the ground, and whose draft of water is such as not to admit of their going further up, may safely deliver their cargoes, or shelter themselves when they come in by way of refuge; but after the aforesaid division the navigation channel M M becomes immediately shallow, carrying however ten feet water till we arrive above the new pier called Pockraw Pier at K; when opposite the ropery and dock-yard it falls a little shallower to nine feet four inches, from thence it holds nine and a half and ten feet, till meeting with the town's pier or key E L, it again breaks into two channels viz. that which stretches along the face of the pier, and that which is called the Blacky Pool. The navigation channel by the pier side, from the aforesaid division, falls off at first to nine, then to eight, and gradually to seven feet water.

The desirable improvement pointed out to me, and which seems of great consequence to the trade of the city, is to deepen the navigation channel quite away from the new pier to the west end of the Town's Pier or Key.

I observed when there, that little or none of the current water of the river Dee, in its common state at low water, goes down either the channel by the face of the pier, or the Blacky Pool, all the outlets from the main stream that might be likely to take this course, being barricaded by stone dykes, raised from two to three feet, or thereabouts, above the

ordinary surface of the Dee's water, so that nothing worth notice, till the water is swelled above those dykes, can go down the above-mentioned channel, save the water of two small burns which empty themselves by the navigation channel. With these helps, however, but principally by the current that passes through it and the *Blackey Pool* during such speats as overflow the aforefaid dykes, the navigation channel is kept open.

It has been proposed to bank in the low grounds lying west of the old pier marked D, so as to pen in the spring tides, and at that place to erect a sluice to be drawn at low water, and by making an artificial scour to deepen the aforefaid navigation channel.

Great effects are capable of being produced by the operation and judicious management of sluices in situations adapted thereto; that is, where there is a great command of fresh water, or a considerable declivity in the part to be scoured. Here as the water to be pent in is not considerable in itself, must be in a great measure tide water, which, as the imbankation would in a great measure prevent all currency through it, would be subject to fill up the reservoir, and the length according to the navigation channel nearly a mile upon four feet only of descent at low water, I fear, these circumstances considered, the effect would not be found answerable to expectation. On the other hand, the imbankation preventing the speats which overflow the dykes from getting in at the head of the navigation channel, the principal natural agent would be prevented from operating, and which I should be sorry to lose. Were the long dyke, marked A A in the plan, broken down and removed, I make no doubt but that in the course of a few years the main stream of the river Dee would make its passage by way of the Denburn into the navigation channel, D E L M K, and by degrees of itself produce the effect desired, and with a little help would do it in a very few years. I state this not upon any supposition that the dyke is likely to be removed, but to shew more strongly the use of such natural advantages as still remain. I do not suppose, however, that any use that can be made of the remaining advantages will of themselves greatly deepen the navigation channel; but this I suppose, that after it is made deeper by art, those natural advantages may be so applied as to keep it equally clean at a greater depth, as they now do at a lesser.

The whole channel from the new pier at K to the town's pier extending from D to L, does not need a great deal to make it good ten feet water, and it may be very successfully deepened by a ballast lighter, constructed like those used upon the river Thames for getting ballast for the ships. Those lighters work by direction of the Trinity House upon such shoals as are most injurious to the navigation of that river, and all the ships of that port are obliged to take their ballast from them at a certain price. Perhaps much ballast

ballast is not taken out from the port of Aberdeen, but such as is, may be supplied by this lighter in aid, as far as it goes, of the expense of raising it.

The channel for the whole length of the pier or key I would propose to be deepened by the mattock and spade at low water, which deepening being done two feet at a mean, will give ten feet water to the middle of the pier where now there is but seven feet six inches; and this being done to a breadth of sixty feet will admit of two vessels to lie abreast with sufficient passage. This work will be attended with no extraordinary expense in proportion to the utility thereof, and will endure for several years before the state of the channel will return to what it now is; yet it would undoubtedly return by degrees to the same state, unless some counter-balance be applied to prevent it: what I would therefore recommend for this purpose is as follows:—

To erect a strong stone dyke beginning at the head of the Inch Dyke at F, in the direction of the dotted line F E to the beacon E upon the Trinity Inch; or if it should any-ways happen to interfere with the Raik Fishing, to carry it from a lower part of the Inch Dyke to the said beacon, according to the direction of the dotted line G E: this dyke to be made so as to rise above and keep in the water of the high land floods at half ebb of the tide, and to be made firm, so that the current may in great land floods at high water go over it, without hurting it; by this means the greatest part of the water that in time of speats flows over the present dykes, and makes its way partly by the Blacky Pool, partly over the surface of the higher lands, and partly by the navigation channel along the face of the pier, will all be constrained to go through the channel alongside the pier, and therefore will be as adequate to keep clear that channel at ten feet depth, as the present channel joined to Blacky Pool is to keep it at that mean depth from their junction to the junction of the main river at the Stell Fishing: and as these operations are plain and simple, and will be attended with no considerable expense, I earnestly recommend their execution.

It is also very practicable in like manner to join the old pier D by a dyke across the Trinity Inch to the elbow of the river, a little above the Inch Dyke B; and also by putting sluices upon the opening between the north end of the old pier D and the west end of the town's pier or key to pin in the tides, in order to make artificial scours: but as the building and maintenance of sluices would be expensive, if made so capacious as not to be an impediment to the current and action of the land flood waters, as above mentioned, and would have no considerable effect, unless the water was pent up higher than the present fishing dykes, (the banks whereof if so would in a great measure prevent the flood waters going that way); it therefore appears that since sluices of any kind are

likely to prevent more good than they will do, that the plain, natural, and simple method first described, of making a dyke according to the single dotted line EF as first mentioned, is the most eligible to be put in execution. Upon the whole, I am of opinion the methods pointed out to be pursued, without and within, will remedy the complaints the harbour is subject to, as far as is above specified, and possibly in a still greater degree.

Aufborpe,
19th February 1770.

J. SMEATON.

ESTIMATE for the North Pier of Aberdeen, &c.

This pier NN being begun at the high ground of a point called Sandnefs Point, marked X, not subject to be overflowed with the tide, may be carried out for 400 feet gradually increasing, being 20 feet base, 12 feet top, and 12 feet high, will contain as follows, videlicet,

	Cube feet of solid rough blocks.	
In the base for 2 feet high	40	
In the side at 3 feet mean thickness and 10 high	60	
In the platform at top	5	
Solid rough blocks per foot running at 4d., £1. 15s.; and for 400 feet length	105	700 0 0
To 87 cube feet of chiefly large and some small rough stones for filling, which reckoning 13 cube feet and a half to the ton (that is, 2 ton to the cube yard), makes 6 tons and a half per foot running, which at 2s. 6d. per ton laid in place amounts to 16s. 3d. per foot running, and for 400 feet to		325 0 0
The parapet being at a medium 4 feet 6 inches base, 3 feet top, and 4 feet high, will contain 15 cube feet per foot running, and reckoning as before 4d. per foot for block stone, 2s. 6d. per ton for walling and filling stones, 2d. per foot superficial over all, for work in facing, and 2s. 2d. per cube yard for mortar and extra work in walling the parapets, will come to 10s. per yard, cube measure, and therefore for 15 feet to 5s. 6d. per foot running, and for 400 feet to		110 0 0
The 1st stretch of 400 feet of the pier		£ 1,135 0 0

The

The 2d stretch being carried out 400 feet farther, being a mean 28 feet base, 14 feet 6 inches at top, and 20 feet high, will contain as follows:

	rough blocks.	
In the base for 3 feet high	60	
In the sides 17 feet high and mean thickness 3 feet and a half	119	
In the platform at top	7	
Solid rough blocks per foot running	186	at 4d., £3. 2s.
To 400 feet in length at £3. 2s. per foot running		1,240 0 0
To 117 tons of large rough stones for filling, at 2s. 6d. per ton, comes to		885 0 0
£2. 4s. 3d. per foot running, and for 400 feet to		200 0 0
The parapet will contain a cube yard per foot running, which for 400 feet at 10s. comes to		£ 2,325 0 0
The 2d stretch of 400 feet of the pier		

The 3d stretch of the pier being carried out 546 feet beyond the former, and being at a mean 36 feet base, 24 feet top, and 24 feet high, will contain as follows:

The base of blocks 4 feet high	114	
The sides at a medium 4 feet and a half thick each	180	
The platform at top	10	
Rough blocks per foot running	334	at 4d., £5. 11s. 4d.
This for 546 feet in length comes to		3,039 8 0
To 28-6 tons of large rough stones for filling, at 2s. 6d. per ton, comes to		1,951 19 0
£3. 11s. 6d. per foot running, and for 546 feet to		546 0 0
The parapet will contain 2 cube yards per foot running at £1. per foot, and for 546 feet		£ 5,537 7 0
The 3d stretch of the pier 546 feet		

The pier head to be 60 feet diameter at base, 48 feet top, and 24 feet high, will contain as follows:

The base of blocks 4 feet high	11,316	
The outside at 4 feet and a half mean thickness	16,920	
The platform	707	
Rough blocks in the pier head	28,943	at 4d. 482 7 8
To 1,940 tons of rough stones for filling at 2s. 6d.		242 10 0
To 54 feet of parapet (being the length that the head is supposed to add to the 3d stretch, making it in the whole 600 feet) at £1. per foot		54 0 0
The pier head making 54 feet running		£ 778 17 8

ABSTRACT

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			£	s.	d.
The 1st stretch containing 400 feet running	-	-	1,135	0	0
The 2d ditto	-	400	2,325	0	0
The 3d ditto	-	546	5,537	7	0
The pier head	-	54	748	17	6
Whole length	1,400	Total of the pier	9,776	4	6
The taking up the bar so as to make two feet water more than at present when clear, with incidental charges, may be supposed	-	-	223	15	6
		Total for the pier	£ 10,000	0	0

J. SMEATON.

Aufthorpe,
19th February 1770.

ESTIMATE for the Interior Works proposed for the Harbour of Aberdeen.

			£	s.	d.
The construction of a stone dyke in the direction F E, specified in the report and plans, being supposed at a mean 12 feet base, 6 feet high, and made rounding at top, will take about 3 $\frac{1}{2}$ tons of rough stones per foot running at 2s. 6d. per ton, and being in length about 1110 feet, will come to	-	-	499	19	0
To clearing the channel from the new pier K to the town's pier L D, in length about 30 chains or 2220 feet, and being supposed to be deepened at a medium one foot upon 60 feet wide, will contain 4933 cube yards, which I suppose may be done by hand at low water for 6d. per yard, will amount to	-	-	123	6	6
To deepening the channel by the side of the town's pier L D, at a medium two feet upon 60 feet wide, for 1700 feet in length, will contain 7555 cube yards, which at 6d. will come to	-	-	188	17	6
The interior works	-	-	£ 811	14	0

J. SMEATON.

Aufthorpe,
19th February 1770.

ABSTRACT

To

To the Magistrates of the City of Aberdeen.

The REPORT of JOHN SMEATON, Engineer, upon the *In-run* of the Seas into the Harbour of Aberdeen in easterly winds.

(See the Plan, Fig. 2. Plate 2.)

IN consequence of the memorial from the magistrates of Aberdeen, dated the 9th of April last, which I received in London from the hands of Mr. Professor Copland, and of your further request signified to me by Messrs. Carnegie and Black of Montrose, I took the opportunity of visiting your harbour, and made my observations upon the place, 1st, 2d, and 3d of October last, at which time the wind happening to be easterly (though not very fresh) afforded me an opportunity of particularly viewing and considering the mode of the action of the seas from this quarter, and had the pleasure to find that the deepening of the the entry into the harbour, and removal of the bar, that was the principal annoyance complained of when I viewed the harbour in the year 1769, has been effectually removed and cleansed, and so kept continually in that improved state by means of the north pier N N, which has been erected conformable to my report of the 19th February 1770. But though the main object has been answered, and the harbour and refort thereto very greatly improved, yet the very means by which this improvement has been effected have produced a cause of complaint of a very different kind, which at the time I apprehend to have been altogether unforeseen, and that is from the increase of depth and freedom of passage, the swell of the sea at high water meeting with nothing to controul it, makes its way through the clear passage between the two piers, and meeting nothing within the great natural bafon or bay that forms the harbour to break or disperse the seas so brought in; according to the nature of waves when passing through a narrow into an expanded space, they turn round along the shore and spend their fury upon the nearest objects in the greater degree, and in proportion upon those more distant.

While the Old Sandness Point remained, which had been formed in former times before the north pier was built, and which extended more than half way across the space walled off by the new pier (as appears by the original Plan at X. Fig. 1.) this point of shoal water while it subsisted was capable of taking up and breaking the heavy seas in rolling over it, and thereby in a great degree dispersing them; but in proportion as the bar was removed and the entry deepened, the seas falling more heavy upon this point, have gradually dispersed and removed it, and in consequence now pass into the harbour without controul, as has been fully and clearly set forth in your memorial above referred to.

The