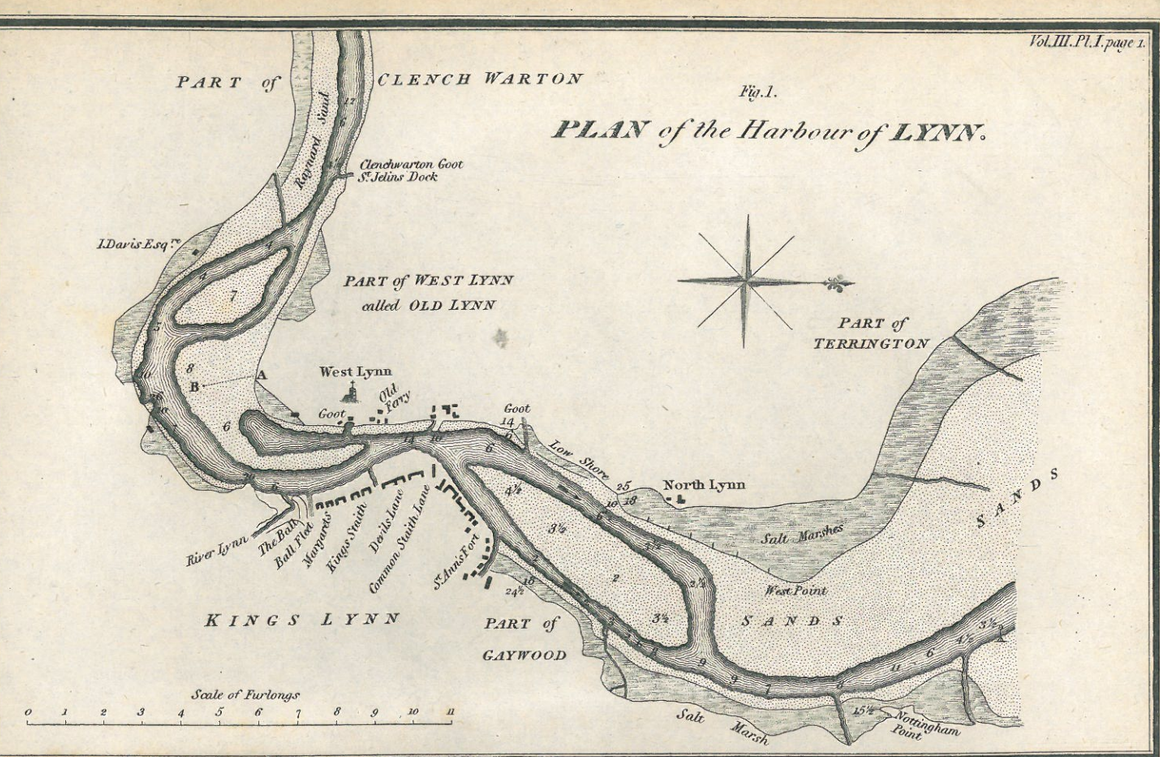
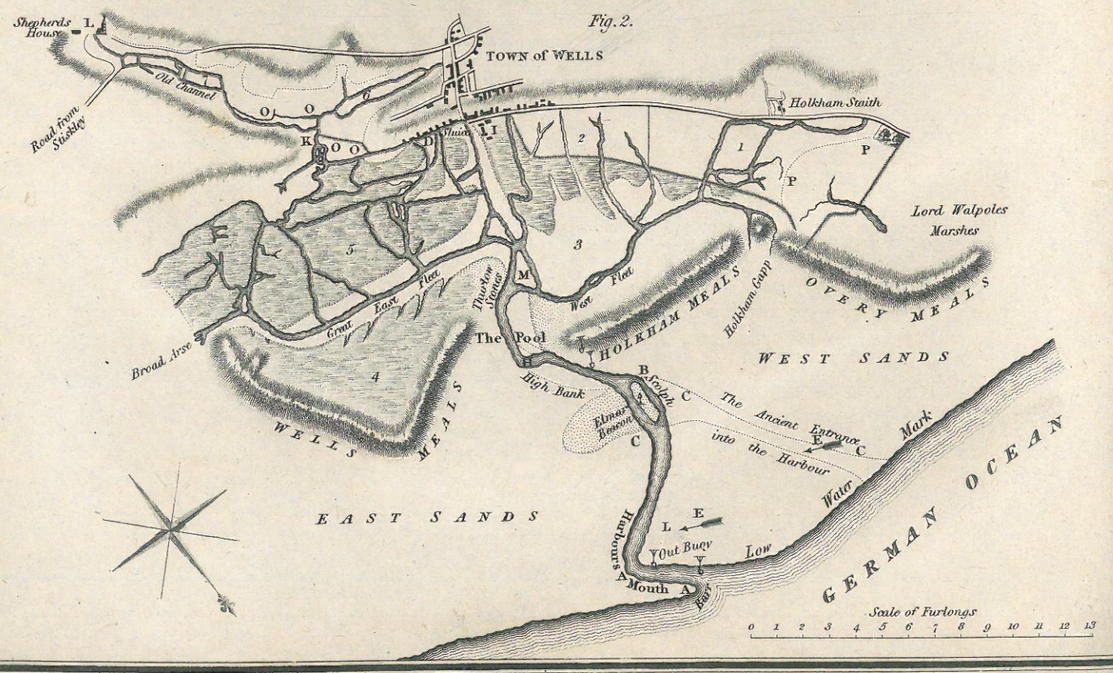
Fig. 1.

PLAN of the Harbour of LYNN.



A Plan of HARBOUR & HAVEN of the PORT of WELLS in the County of NORFOLK.

Fig. 2.



J. Farey Jun.r delin.

Engraved by W. Lowry

Published as the Act directs, 1812, by Longman, Hurst, Rees, Orme and Brown, Paternoster Row, London.

REPORTS, &c.

KING'S LYNN HARBOUR.

The REPORT of JOHN SMEATON, Engineer, relative to the Harbour of *Lynn* in *Norfolk*.

THE Matters to be reported upon as given me in charge by the Magiſtrates of *Lynn*, were principally the following:

Firſt, The preſervation of veſſels lying in the harbour of *Lynn*, from the annoyance of winds and waves; not only from the ſea, but from the broad river above the town, when the wind happens to be in that quarter, and alſo from the raging tides that often accompany them, and drive the Veſſels from their moorings:

Secondly, The preſervation of the banks of the river, and more eſpecially thoſe near the town, from the action of the winds and ſeas, accompanied alſo with too rapid a tide.

The better to enable me to acquit myſelf upon theſe ſubjects, I carefully examined the channel of the river *Ouſe*, from the roads near the *Ferror Beacon* to *German's Bridge*; and alſo the banks thereupon, and more particularly thoſe within two miles of the town

Note.—In the plan of the harbour, Fig. 1. Plate 1. the figures in the channel ſhew the depths in feet and half feet at low water; the other figures ſhew the height of the ponds, lower ſhores, ſalt marſhes, and banks above low water mark.

of *Lynn*. I have alſo carefully viewed and examined the circumſtances attending the ſaid river, from *German's Bridge* to *Denver Sluice*; ſo far as they appeared to me to have any relation to the buſineſs before-mentioned.

In the courſe of theſe enquiries, I had the pleaſure to find, that the channel of the river, and particularly that part to ſeaward, not only from the accounts of the pilots who attended me, but from my own remarks, compared with former accounts and reports, was, at the time of thoſe obſervations, *viz.* in the month of *July* 1766, in as good condition as it had been known for many years; and in fact without any material cauſe of complaint. That a bar had formed itſelf in the upper mouth of the weſt channel, and that the current at low water was wholly confined to the eaſt channel, which had in conſequence proportionally improved.

This is indeed a very material change in the ſtate of the channel and harbour for the better; the contrary condition having been complained of for years paſt, *viz.* the choaking of the harbour and channel to ſeaward with ſands, and the great tendency of the current to take the weſt channel inſtead of the eaſt; which latter (as it ſeems) was that, which, according to the unanimous opinion of all thoſe who have reported upon it, was the deſirable channel to be maintained, and if poſſible improved; the doing of which has been the ſubject of much projection and altercation: but as nothing appears to have been done in conſequence, but that Nature has very kindly brought matters into a more deſirable ſtate, it ſeems of the utmoſt importance to propoſe nothing for execution, that ſhall counteract her intentions; nor while we are relieving one evil induce a greater.

According to all accounts, the point below the crutch on the eaſt ſide of the river, called at preſent *Nottingham Point*, projected much further to the weſtward: and another point of land on the weſt ſide of the river, below *North Lynn*, but above the ſaid *Nottingham Point* according to the courſe of the river, projected further eaſtward; ſo that, to a perſon ſtanding upon the quay called the *Common Staith*, at *Lynn*, the ſea was land locked by theſe two points; but that now, by the gradual wear of one or both of them, an obſerver ſtanding at the ſame place, will, at high water, ſee the ſea conſiderably open between the ſaid points; and the wind being in that or nearly that direction, that is, betwixt N. N. W. and N. N. E. and a ſtrong ſpring tide of flood, the ſhips are apt to ride very unquietly that lie within the point formed by the *Common Staith* and the *Ball*, which may now be reckoned the port of *Lynn*, and where the ſhips chiefly lie to be loaded and unloaded from the merchants' yards.

This evil I find has been complained of for many years; and in the year 1741, a ſcheme was offered by Mr. *John Roſewell*; which was to build jetties from theſe two points ſo as to produce the ſame land lock as formerly: and this he imagined would not only redreſs this immediate grievance, of too much ſwell running into the harbour, but alſo others at that time alſo greatly complained of; that is, obſtruction by ſand, too ſhallow a channel, a high bar in the eaſt channel, and too great a diverſion of the current into the weſt channel.

That thoſe jetties might be of ſome uſe in checking the ſwell of the ſea, cannot be denied; but the ill effects they were likely to have by encreaſing the tendency of the out channel to the weſtward, is ſet forth with great juſtneſs and ſpirit, in a ſmall pamphlet, publiſhed in the year 1742, entitled, *Some thoughts on Mr.* Roſewell's *and other Schemes, now propoſed for amending* Lynn *Channel and Harbour**; which, as I ſuppoſe it in every ones hands, to ſave repetition, I recommend to a re-peruſal, from the beginning to and including the 9th page. And indeed Mr. *Roſewell*'s reaſoning, if ſuch it can be called, concerning the improvement of the eaſt channel by means of thoſe jetties, has not been more ſolidly refuted by the author above referred to, than it has ſince been by Nature herſelf: for it ſeems very manifeſt, that in proportion as the points, particularly *Nottingham Point*, have been worn away, the channel has tended more eaſtward; and has improved in proportion as the weſt channel has decayed, which muſt be expected from an union of the two forces. As therefore the maintenance of the channel out to ſea, in the good condition in which I found it, I look upon as a *primary* conſideration; I entirely agree with the author before-mentioned, that it would be a dangerous expedient to reinſtate the two points above-mentioned, by the building of jetties: on the contrary, I am of opinion, that where a channel muſt be maintained through a vaſt maſs of ſand, capable of ſhifting by winds, ſeas, currents, and every temporary impreſſion of power thereon, that the more directly the waters make their paſſage out to ſea the better.

Nor am I very clear, that the reinſtating of the points would entirely cure the evil at preſent complained of; they being at too great a diſtance from the interior harbour, and muſt neceſſarily be placed at ſo conſiderable a diſtance from each other, that unleſs the entry was entirely ſpoilt, I apprehend the ſeas would ſtill find the way within the heads: and in ſo long a fetch to the place where the ſhips lie, would gather and ſtill diſturb them at their moorings.

Nor can they be of much uſe in checking the too great indraught of the tides, at preſent complained of; for the paſſage between them muſt be very narrow to produce a

* This pamphlet is anonymous, but I ſince underſtand was wrote by Mr. *Elſtobb*. See Appendix to this Report.

ſenſible effect, and in proportion as it was contracted, it would wear deeper, and thereby ſtill admit nearly the ſame quantity of water to paſs. Yet, if they could be ſo made as to check the raging tides, they would check the moderate ones too; and I believe all agree in opinion, that in the ſituation of *Lynn* harbour, the greater the efflux, which in great meaſure depends upon the influx, the better channel may be expected to be maintained: too great tides may be a partial and temporary evil, but it appears to me in the preſent caſe a fault on the right ſide; and it ſeems that in this, as well as many affairs of human life, the judgment conſiſts in chuſing *the leaſt of two evils*.

I cannot however agree in recommending the expedient mentioned in the latter part of the pamphlet above quoted; that is, damming up the old river at the weſt point, and cutting a new one through the land, down to the road; for this, if not made equal with the mean capacity of the old river, would check the influx of the tides; and if ſo made, would be a moſt monſtrous expenſe, and at laſt the event would be uncertain; for by producing an alteration in the ſet of the currents, without the mouth thereof, it perhaps is out of the power of human foreſight to ſay with certainty, that (after ſo great an expenſe) ſome bar or impediment might not be thrown up, producing an equal obſtruction to thoſe then complained of; but thanks to Nature for relieving us from the neceſſity of ſo chargeable an expedient, and giving us the opportunity of *knowing when we are well*.

The ſimple point of view, that in my opinion is neceſſary to be attended to for the preſervation of the channel, is to do nothing *materially* to affect the indraught of the tides, or to diminiſh the quantity of freſh waters coming down the river from above: as to the reſt, it muſt be left to Nature, and though in ſuch a multitude of acting forces and diſturbing cauſes, the goodneſs of the channel muſt by turns become *better and worſe*; yet the grand principles of preſervation being maintained in all the vigour poſſible, after a wrong turn happens a right one will ſucceed, as experience has ſhewn to be the caſe; at leaſt leave Nature to herſelf while tending right, it is time enough to help her when we are ſure ſhe is going wrong.

It is obſervable, that the point formed by the *Common Staith*, and running out betwixt that and *Common Staith Lane*, may be conſidered as the jetty, whereby the ſhips lying above in the interior harbour, are ultimately defended from the ſwell coming in from the ſea; and it is only the ſwell that gets round this point from the ſea that affects the ſhipping; for in fact, the ſhips that lie in the channel of the river, between the *Purfleet* and the *Ball*, are land locked by this point. This jetty has very much the appearance of having been artificially carried out as well as defended by ſtone wharfing for this very purpoſe.

purpoſe. The river is however ſtill a furlong, that is, 220 yards, wide at this point, according to the plan; the channel lies over to the oppoſite ſhore, where it is ten or twelve feet deep at low water, whereas it gradually ſhallows towards the *Lynn* ſide, leaving the ground dry at low water for above a chain in breadth.

If I were obliged to recommend ſomething in the *jetty way*, it would be to run out this wharf about a chain further, that is, twenty-two yards, being one-tenth of the whole width of the river. I am very clear that ſuch a projection, immediately before the ſhipping, would afford more protection than ſix times as much work done at the two points below; which are at the mean diſtance of a mile and half; and this without being attended with any ill effect upon the channel below. The only objection that I ſee to this ſcheme is, that by narrowing the channel in this the narroweſt place, it would in ſome meaſure check the influx of the tides; and throw the water more powerfully upon the oppoſite ſhore, juſt below the ferry, the defences of which are already too weak: but if this bank were effectually defended by a ſufficient body of rubble ſtone, applied in ſuch a way as I ſhall mention, when I come to ſpeak upon the defence of the banks, the effect would be to ſcour out a channel ſo much deeper in this place, as, by creating an equal ſection, would furniſh the ſame quantity of tide water as at preſent, and probably might deepen the channel on the *Lynn* ſide; at leaſt ſomething might be done to intice it to act in that manner.

It is obſervable, that at the end of *Common Staith Lane* there is a conſiderable prominence of rubbiſh that has gradually been formed, and that ſomething of the ſame kind has been thrown out partly from the lanes, and partly from the houſes, quite away to the *Purfleet*, and higher: I look upon it, that it is owing to this body of rubbiſh, that the channel of the river edges over ſo ſoon to the weſt ſide; if this body of rubbiſh were dug away as near to the buildings as can be done with ſafety, and taken down to or below low-water mark as far as the *Common Staith*; that the ebb tides, accompanied with the land floods, would improve the channel, and enable the ſhips to lie not only lower down, but cloſer in, and thereby more effectually ſhelter them from the ſeas, which would be broken off by the *Common Staith* point; and this is a ſtep that I would recommend, whatever becomes of the propoſition of an extenſion of that point.

I come now to the defence of the ſhipping when the wind is at S. W. or weſterly; that is, when it blows right down the broad river which extends above the town; and with this view it obviouſly occurs, that if a jetty or break-water were carried out upon the ſands from the point above *Old Lynn*, this would in ſome degree ſhelter the ſhipping that lie from the *Ball* downwards: but yet, unleſs the jetty be extended from A to B in the plan, that

that is, the length of a furlong, or 220 yards, the veſſels lying at or near the *Ball* will ſtill be expoſed almoſt as much as before: on the other hand, this work will throw the current more forcibly into the bite or great hollow oppoſite this point, where the water ſets already too hard, and is making daily depredations. I would therefore beg leave to ſuggeſt, that as no ſhip lying from the *Ball* downward, can be ſubject to a direct fetch of more than a mile in length; and ſince in this length no great ſwell can be raiſed, but only a ſhort chopping ſea or windwaſh, which would ſignify little, independent of the force of the wind and a ſtrong tide of ebb, both which muſt remain; I ſay, I would put a query, whether it would not be adviſeable at once to endeavour to encreaſe the ſecurity of the veſſels in the harbour, by improving their moorings; which I apprehend might be done by putting down a row of ſtrong *dolphins* on the weſt ſide of the channel in the middle of the river; and continuing the line lower down, and increaſing in number thoſe that are on the eaſt ſide. This meaſure, independent of every thing elſe, would be a great ſecurity againſt diſturbance, both from land and ſea. However, if the magiſtrates are inclined to begin a jetty or break-water from the S. W. point in or near the direction ſpecified in the plan, in order to try the effects of it, I would not be underſtood to diſcourage the attempt; and if not carried beyond the limits there ſpecified, I apprehend any ill effects that it might have upon the oppoſite bank might be guarded againſt. It may be begun with rice and rubble ſtones, and afterwards by ſinking old veſſels; or continued with the former materials, as ſhall appear in the execution beſt to anſwer the end.

I come now to the ſubject of the banks: and on this head, as I have already declared that my opinion is in general, to diſcourage all attempts to prevent the free influx and efflux of the tides and land waters, in order to preſerve the channel out to ſea in the moſt effectual manner, upon which both the navigation and drainage dependent on the *Ouſe* entirely hinge; nothing remains to be done with the banks, but to make them ſtout enough and high enough to ſtand againſt all extremes: my buſineſs will therefore be, to ſhew how this is to be effected. To give directions about the particular parts would be endleſs, and will be the proper buſineſs of the ſurveyor, who ſhall be entruſted with the execution thereof; I ſhall therefore content myſelf with ſhewing the general principles, which will eaſily be applied by the judicious artiſt to the particular caſes.

In the firſt place, I entirely diſapprove of all jetties built into the ſtream, as a defence for ſaving the banks or foreſhores from the action of the water, as I am convinced from many obſervations that they have a direct contrary tendency; for they ſeldom fail of producing a deep pit, either oppoſite to, or on the downſtream ſide of the jetty, which tends

tends to undermine the banks, and even the jetty itſelf; ſo that thereby the *rent is made worſe*.

Whatever works are attempted for the preſervation of the foot or banks of foreſhores, when too hard a *ſet* of the water tends to undermine them, ought to be diſpoſed parallel, or according to the direction of the ſtream; ſo that the water, inſtead of being ſtopped or thrown off, ſhall glide gently by, with the leaſt interruption poſſible; for thereby the water gets away with the leaſt poſſible action upon the banks, and conſequently wears them or their defences the leaſt. For this reaſon all angles and ſudden turns are to be avoided as much as may be, and where a turn muſt be made, as very frequently happens, let it be made with as eaſy a ſweep as poſſible, keeping it as near as may be the ſame with the natural, that is, the general *bend* of the river, cutting or rounding off all ſmall ſudden turns, angles or extuberances, which may happen in the general ſweep; which directions will hold, as well for forming the baſe and middle lines of the artificial banks themſelves, as for preſerving the foot of the natural foreſhores, whereon the other is founded. To act otherwiſe is to oppoſe a natural current, and to oppoſe a natural current is to give it ſomething whereon it may inceſſantly act, towards the deſtruction of the oppoſed work; which in the caſe of banks and their defences, is to do ſomething contrary to the very intent of doing it.

This doctrine cannot be better illuſtrated than by the two great jetties, in the turn above the *Ball-fleet*, oppoſite and juſt below which are five and ſix fathom water; whereas the natural bottom or depth is not more than as many feet. By this means their foundations are ſapped, as well as the adjoining banks, which in conſequence muſt be ſubject to very expenſive repairs, as the bite of the river will grow deeper on every alteration.

This is alſo the caſe with a number of jetties on the weſt ſide of the river below the ferry: to ſay the truth, I ſcarcely ever ſaw an inſtance where this ſort of works, when applied as a defence to the banks, did not do miſchief; it would be very well that they were all removed, or if this is thought too much expenſe, at leaſt never more to be repaired in their preſent form.

Where the ſides of a river or foreſhores grind away by too great ſtreſs of water, the moſt infallible, ſecure, and laſting method of doing it is, after the ſudden extuberances and irregularities of the curve are taken off as low as the water will admit of by hand, to line up the foot with rubble ſtones, thrown in promiſcuouſly, ſo as to form

form their own natural ſlope againſt the ſhore, till they appear above water, at low water. This being done for the whole length of the galled place, with the regularity before deſcribed; and being further ſupplied with a freſh quantity after a ſettlement has happened, in conſequence of ſucceeding great tides and floods; will prove a laſting ſecurity againſt further depredations at the foot; and the foot being well ſecured, Nature will, in moſt caſes, where there is room to do it, form of herſelf ſuch a natural ſlope to neap tide high-water-mark, as will need no artificial defence. The chalk and clodlime rubble that is brought down the river, ſeems a very good material to be employed in this way, but the rubble of any ſtone that will bear wet and dry will do, which can be procured cheapeſt; the larger and more irregular, both in point of ſhape and ſize, the better.

The ſame defence, where ſtone is wanting, may be procured by the application of ſtakes and rice; but diſpoſed, as before directed, even and parallel to the ſtream*, without jettings or extuberances; but nothing can be done with theſe materials comparable to rubble ſtones, on account both of want of weight and duration.

It may poſſibly be objected, that a ſufficient quantity of rubble ſtones, to ſecure the foot of the banks and foreſhores in this manner, will be expenſive; and in ſome caſes poſſibly it may; but it muſt be conſidered, that here will be no expenſive tide-works, with a number of men, and that there will be very little additional charge beyond that of bringing down the ſtones; but in preference to all methods that are in themſelves ineffectual, the cheapeſt way is to do nothing.

The baſe of the bank and foreſhores being ſecured as above deſcribed, it has already been ſaid, that where there is room enough, Nature will herſelf form a ſlope upon the foreſhores up to the high-water-mark of neap tides, which will be of itſelf a ſufficient defence againſt waves and currents; and where there is no want of room to form a ſufficient ſlope above the neap tide high-water-mark to the top of the bank, there is no better way than to ſlope and turf it over, in the manner that has already been put in practice, but above and below the town of *Lynn*; and alſo on the other ſide of the water. I can give no better directions than theſe ſpecimens will afford, which ſeem done with great judgment; only that, inſtead of uſing any wood at the foot of the turf about neap tide high-water-mark, I would adviſe to rely wholly upon a *lay* of rubble ſtone; and if ſome of it is broken ſmall ſo as to fill up the interſtices of the larger pieces, this will form a more complete union between the rubble and the turf, than if compoſed of large ſtones only.

* The ends outward, and a little inclining down ſtream.

Where

Where the artificial banks ſtand ſteep upon the foreſhores, I obſerve that the practice about *Lynn* has been to defend them by a boarded wharfing. This at firſt ſeems to promiſe much ſecurity; but experience has proved that this is only *outſide*: and if we conſider the action of the waves upon it, we ſhall find this method not at all calculated to ſuſtain their ſhocks for any length of time, the very union of the parts being the cauſe of their deſtruction.

If the ſea daſhes againſt the end of a faggot or a ſtone, theſe having no ſolid connection with their neighbours, the impreſſion goes no further; but the tremors raiſed in one part of a boarded wharfing is communicated to the whole, or to a large area; which, accompanied with the great ſhocks that muſt unſue when a conſiderable part of the ſurface is ſtruck together, theſe agitations by little and little ſhake and looſen the earth behind, which by the riſe and fall of the tides is by degrees waſhed out at the foot and through the crevices, which brings the whole to ruin. This, accompanied with the ſpeedy decay of all wood work expoſed to wet and dry, makes it ſeem to me quite eligible totally to diſcard this method in all future repairs. In lieu whereof I would recommend the following: wherever the foreſhores are not broad enough from low water to neap tide high-water-mark, to ſtand by a natural ſlope, I would adviſe them to be reduced to a ſlope of two to one; that is, to batter two feet to one foot perpendicular; and this being covered a foot thick with rubble ſtone of all ſizes bedded together, and footed upon the rubble, ſuppoſed to be thrown in to ſupport the ground under low-water-mark, will, as I have often experienced, make a very laſting defence, and is capable of great reſiſtance in all ordinary caſes; but if expoſed to the waves of the open ſea, the cover muſt be increaſed in weight and thickneſs. This method will anſwer the end, if the batter is three to five, or even one to one; but the latter I would not recommend without extreme neceſſity.

With reſpect to the upper part of the bank, from the high-water-mark of neap tides, to the high-water-mark of the equinoctial ſpring tides; I would, in all caſes where it is poſſible, ſhift back the banks, till they will admit of the ſlope and turf method above referred to; but if this be not poſſible, to continue the ſame batter as the foreſhore, and to face the artificial banks with ſtone in the ſame manner as already deſcribed.

I do not know of any ſecurity againſt *inundations*, in a country that is defended by banks, otherwiſe than by making thoſe banks, not only ſufficiently ſtrong, but high enough to ſuſtain the greateſt extreams, without being overflown: and it is from *experience alone*, that theſe extreams are to be learnt.