## P L A N

 for the improvement of
## $D U B L I N H A R B O U R:$

 TOGETHER WITHA PROJECT FOR A NEW ONE,
DENOMINATED
Dublin Life Harbour;

A DESIGN FOR AN EXCELLENT OUTERharbour, by an new entrance - ., TO THE PRESENT ONE;
with
AN EFFECTUAL METHOD OF CLEANSING AND DEEPENING, THEM.

BY WM. M $\subseteq$ MENAMY.
MASTER OF THE HIBERNIAN MARINE SCHOOL.

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D U B L I N:
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## ( iii. )

TO the Right Hon. and Hon. the Directors General of Inland Navigation in Ireland. E'c.

Gentlemen,

AN effectual method for the Improvement of Dublin Harbour, occurred to me many years fince as a matter of mere fpeculative curiofity, which would always obtrude itfelf on the mind whenever any melancholy accident happened on our coaft, and occafion much regret at the flow operations of Nature to accomplifh what I then had little hopes of ever feeing promoted by Art, until our late Parliament were pleafed to make inquiries as to the practicability of fome general plan for effecting fo defirable an object. I communicated my project to fome Gentlemen high in office, who defired me to draw up my fentiments on the fubject for their perufal, which accordingly I did in November laft, after which they were pleafed to advife and encourage me to prefent the paper to your Honours; therefore I now take the liberty of fubmitting it to your confideration, and of fubfrribing myfelf,

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WM. M ${ }^{\text {‘ MENAMY. }}$


















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## A Plan, \&c.

THE moft general and rational project for the improvement of the Bay and Harbour of Dublin, which would afford fafety to fhipping in cafe of ftorms, remove the prefent obftacles to its navigation, and prevent fhipwrecks on our coaft, we hope will peedily be adopted, efpecially as the government has interpofed in the caufe of humanity and the profperity of the metropolis of the kingdom, by appointing certain gentlemen as able directors-general of navigation for improving the harbour, and competent of appretiating the moft judicious plan for that purpofe.- The many valuable lives and immenfe property that are annually loft by fhip-wrecks about our Bay and Harbour, will doubtlefs ftimulate many perfons to offer their fentiments freely on the beft means for averting the recurrence of fuch melancholy accidents; in which cafe many vifionary fchemes, it may be expected, will be propofed by fome who are ignorant of the laws of Nature or of Science, either from humane or interefted motives, which necefsarily muft be rejected: But the
fuggeftions of the well-informed from whatever motive, it is hoped will be fully inveltigated before they are either neglected or fuperfeded.

The author of the following plan is not however too fanguine in his hopes of preference to his fpeculations on the fubject ; yet, profefsing fome knowledge of the fciences, and having made the motion and equilibrium of fluids his ftudy thefe many years, which the duties of his public fituation in fome meafure required, befides having been the first (and only one) that ever calculated and publifhed Tide Tables, exhibiting the daily depth of water on the Bar, to which were affixed a fmall chart with a nautical defcription of the Bay and Harbour ; alfo failing directions for avoiding the banks, and crofsing the Eaft and South Bars of Dublin; all which being greatly approved of by the public, encourages him to hope for an equal attention to his obfervations and reflections on the origin and phyfical caufe of Shoals and Sand-banks, particularly on our own coaft, with the natural means of their radical cure or removal, and confequently the moft rational improvement of the harbour, on the general principle of afsiting Nature in her operations, by removing the caufe, whereby the effect will ceafe. The improvement here propofed would require little expenfe to execute, compared with the importance of the object and the advantages to be thereby derived; and is an improvement that would never decay or require additional expenfe to perpetuate.

It is unnecefsary in the enquiry to difculs the theory of the Tides, we fhall therefore only mention their ge-
neral courfe and direction, which is from E. to W. following by attraction the apparent courfe of the Moon. The flood-tide rifing in the northern ocean, glides along: the coaft of Norway, from the N. Cape to the Naze ; and becaufe its general courfe to the weftward is interrupted by Great-britain, it ftretches to the foushward, along the E. coaft of Scotland and England, ${ }^{\text {till }}$ it falls into the Englifh channel, filling up in fuccefsion all the vacancies that happen in its way, in whatever direction they lie; for as water muft naturally find its own level, and take the eafieft pafsage when permitted, thefe confequences muft necefsarily follow : Alfo, while the flood-tide is gliding to the fouthward, along the Wert coafts of Scotland and Ireland, a branch of it falls into St. George's channel fetting to the fouthward paft Dublin, 'till it meets the other part of the general tide about Carlingford, which fets to the fouthward through the Irifh channel.

Tho' the flood-tide about mid-channel fets paft Dublin to the northward, in a direct channel-courfe, unlefs diverted out of its way by fome obftacle, yet the tide in fhore muft partake of all the meanderings of the coaft along which it glides, winding round all the promontories or projections, and falling into all the bays, hollows, cavities and rivers it meets with in its progrefs, as was hinted above, and for the fame reafon that water will find its own level, and takes the eafieft pafsage. Now, if any-of thofe hollows lie fo deeply imbayed or greatly land-locked, as to form the much greater fegment of a circle, or has its entrance fo athwart the current as to lie partly on the oppofite direstion thereof,
then the ftream will ftrike the oppofite projection, and wind in on that fide, caufing a counter-current or eddy in the hollow. Or even in a wide hollow bay the current along thore fuffers a greater refiftance by the friction of the coaft, than the pafsing current in the offing; it has therefore lefs energy, befides the current fhould defcribe a greater diftance along the incurvated coaft, than in the direct line of offing in the fame time with a given velocity, which is impofsible; and confequently, on both accounts, will alfo occafion an in-fhore countercurrent or eddy, and an indraught* of water on the flood, to fupply or fill up the expanfive hollow. Hence we may perceive why the firft of the flood or ebb-tides may in many places have a very different direction from the latter part thereof.-Again, as the current parses along any ftraight coaft, it muft move with greater velocity than in the adjacent hollows, and ftill much greater as it pafses round any cape or projection, or thro' any narrow channel oppofite to a ftraight coaf, or oppofite any projection of land into the fea; because in thefe latter cafes, the water is more contracted than in the hollow, where it has more room to fpread itfelf.Every great wave or fend of the fea muft alfo ftrike a ftraight coaft or projection into the fea, with much greater violence than in deep Bays or fhelving fhores: Hence the reafon why the tides rife higher on a flat fhelving coaft, and up rivers, than in the open fea, partieularly in rivers that are of great extent, of moderate declivity, contracting banks, and their courfe oppofed to the courfe of the flood-tide : For a great wave or fend

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of the fea, muft neceffarily make an horizontal motion on thofe flats or mouths of rivers to a confiderable diftance, and before it can return, is met or fucceeded by another wave, which will heap up the former on top of the latter, which is ftill flowing in underneath, continuing with fuccefsive impulfes, until the accumulated water by its gravity obtains an equilibrium with the impulfe of the wave or furge, and therefore may rife the tides at thofe places to great heights under fuch circumftances.

If either by a combination of natural caufes, the ravages of time, or any violent convulfion of nature, the waters fhould rife to an unufual height, or the land fubfide below the level of the fea, then the tide will overflow the lower grounds or flats, and by its rapidity and reciprocation, break down the fea boundaries, delapidate the plains by wafhing away the foil, or covering it with fand brought from the adjacent fhores, or its own banks, by the recurrence of the waves, or partly from both caufes, occafion extreme terror to every wayfaring mariner.

The natural effects of thefe principles are in general, that as the water violently pafses by, or dafhes againft thofe bold projecting flores, or through thofe narrow channels oppofite to them, it wafhes away all the loofe fand, earth, fmall gravel, or other light fubftances it meets with, or dafhes off the banks into the ftream by the recurrence of the waves: the quantity of fand, \&c. removed, is proportional to the velocity of the water, which is again depofited in the eddies, flack or ftill water, deep bays, or retired fhelving flats along the coaft, that
that lie out of the race of the currents of flood and ebb; or it is formed into banks or bars by its fubfiding at the points of congrefs, or recefsion of contrary currents, or where the force of one current is nearly balanced by the force or refiftance of the fea inertly oppofing, or actively fetting againft it. Thefe banks or bars can never accumulate above a certain height, viz. the place of the equilibrium of the re-actions of the under-water; fo that if the place of the equilibrium can by any means be removed to a greater depth, the bank will naturally wear away by the prevailing current ; but if it be removed to a lefs depth, the bank will accumulate.-Hence by the drifting of thofe fands, \&c. and their concretion, we have the origin of fhoals, banks, and bars (unlefs thofe that have not been generated, but either created there at firft, the remains of inundated or funken iflands, or the overflowing of low grounds, by the violence of the fea breaking down the antient boundaries, \&c.) and from the analogy of the drifting of fnow to the drifting of thofe fands we acquire accurate ideas of their formation ; befides an attentive review of the coaft and currents, with a diligent and judicious application of the foregoing principles will enable us to develope their phyfical caufe, and their cure or removal if pofsible by applying natural means, as may hereafter appear ;-But before we difmifs this part of our enquiry, we wifh to confider a certain hydraulic principle which is of frequent ufe in the improvement of harbours, but has not been fufficiently attended to by any author on that fubject which we have met with.

Many gentlemen affirm that fones of great fize have been removed and dafhed out of their places, by a heavy furge ; we have heard fome of the contractors for building the South-wall declare, that feveral of their largeft ftones have been torn from their places by a form and rolled to a confiderable diftance, even after being flrongly crampted with iron; while other gentlemen of fome knowledge and experience doubt the poffibility of it, by reafon that a ftone fpecifically heavier than its bulk of water will neceflarily fink, where they imagine it will remain ; but it is eafy to reconcile thefe feeming contradictions, and fhow in what cafes they are refpectively right or wrong; for if a large fone is conftantly immerfed, it would require a great velocity of the water to remove it ; but if it be alternately bare and immerfed with waves, a much lefs velocity of water will remove it, becaufe in the firft cafe the action of the water is by prefsure only, and in the latter cafe by percuffion, which every artificer knows to be vaftly more powerful in its effects. Hence arifes the following curious new problems, whofe folutions would be extremely ufeful to an enginer, who might be required to cleanfe an harbour of its fand-banks, build pier-heads, or erect break-water ramparts, \&c.

Problem I. Required to determine the magnitude of a ftone of a given fpecific gravity, that may be in equilibrium with fea-water, moving with a given velocity?

Pro. II. Required to determine the magnitude of a like ftone which might be in equilibrium with a given wave of the fea, acting by its percufive impulfe.

Now the confideration of the fecond problem not being immediately neceflary in our prefent inquiry, we fhall defer its folution to another opportunity, and pro. ceed only to the inveftigation of the firft.

By the principles of mechanics, the refiftance to a plane moving againft a fluid at reft, or which is the fame thing, the action of the fluid moving againft a plane furface at reft, is equal to the weight of a column of the fluid whofe bafe is the plane furface and height equal to the height from which a body would fall in vacuo, to acquire the velocity with which the plane moves; -and from the fame principles, a globe is refifed only half as much as a plane furface of equal area with a great circle of the globe. Thefe principles premifed, let the ftone whofe magnitude is required, be of a globular form, and let its diameter be reprefented by *) ; its fpecific gravity to that of fea-water, equal to $2 \frac{3}{7}$ $=d$; the weight of a cubic foot of fea-water equal to $64{ }_{8}^{3}$ pounds avoirdupois, $=e$; the fpace thro' which a body would fall in vacuo in a fecond of time, as found by the moft accurate experiments, and the theory of pendulums, equal $16 \frac{1}{12}$ feet $=s$; the area of a circle whofe diameter is one equal, $7854=a$; and let the velocity of the water $=v$; then $\frac{v^{2}}{40}=$ the height from which a body would fall in vacuo to acquire the velocity $v ; \frac{a \times 2}{2}=$ half the area of a great circle of the fone, and $\frac{2 a \times 3}{3}=\mathrm{its}$ geometrical folidity; hence $\frac{v^{2}}{4 s} \times \frac{a \times 2}{2} \times e=$ the action or force of the water againft the ftone to move it. Now it is plain that when the relative weight of the ftone in the water becomes equal to this force, the weight of the
ftone will be in equilibrium with the action of the water, fo that if the velocity of the fluid be ever fo little increafed, or the magnitude of the fone diminifhed, the current will overcome the gravity of the fone; but $\frac{2 a \times 3}{3} x^{e}=$ the weight of the water of equal bulk with the ftone; confequently $\frac{2 a \times 3}{3} \times e \times d$ is equal to the weight of the ftone in air ; and $\frac{20 \times 3}{3} \times 0 \times d-\frac{20 \times 3}{3} \times e$ $=$ to its relative weight in the water $=$ to $\overline{d-1} \times \frac{20 x_{3}}{3} \times e$ $=$ by the preceding principles to the force of the water, againft the ftone when in equilibrium with its relative weight, hence $\overline{d-1} \times \frac{2 a \times 3}{3} \times s=\frac{v 2}{4^{s}} \times \frac{\mathrm{ax}}{2} \times s$, and therefore $x \equiv \frac{3^{v^{2}}}{16 \mathrm{~s} \times-1}$ feet, or $x=\frac{9 \mathrm{v}^{2}}{45 \times \mathrm{d}-\mathrm{I}}$ inches. Q. E.I. Now let the current move at the rate of 4 knots or miles per hour, or $4 \times \frac{5}{3}=6 \frac{2}{7}$ feet per fecond $=v$, then $x=$ $\frac{9 v_{2}}{4 \circ X^{d-1}}=4,352$, or $4 \frac{7}{20}$ inches, nearly equal to the diameter of the fone in equilibrium with the force of fea-water running at the rate of 4 miles per hour; or a fone equal in weight to $3 l b .140 z \cdot \frac{1}{3}$, avoirdupois; and if the celerity is at the rate of 3 knots, its force will be in equilibrium with a ftone of 2,448 , or $2_{9}^{4}$ inches in diameter nearly, and its weight 11 ounces. \&c. But the ftone muft be driven to the diftance of 7 or 8 miles during the tide of flood or ebb , to be of ufe in our plan; fuppofe $7 \frac{1}{2}$ miles, or at the rate of $1_{4}^{1}$ miles per hour at a medium, that is at $2 \frac{1}{12}$ feet per fecond of time, then the velocity of the current acting againgt the flone, is only the difference of thofe of the tide and ftone, that is $6 \frac{2}{3}-2_{T_{2}}^{\frac{1}{2}}=4_{T^{2}}^{\frac{7}{2}}=v$. Hence by the preceding inveftiC

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gation, $x$ or the diameter of the ftone whofe weight is in equilibrium with the action of the tide on it during the fix hours of its motion, and carried $7_{2}^{1}$ miles, the tide moving at 4 miles per hour, is equal to 2,0571 , or $2 \frac{1}{18}$ inches nearly, and its weight equal to $6 \frac{4}{\circ}$ ounces: but if the current was only to move at the rate of 3 knots, then the diameter of the fone that would be driven $7_{2}^{1}$ miles during the time of the tides motion, would be 8336 , or ${ }_{6}^{5}$ inches nearly, and its weight equal to 4379 , or $\frac{7}{16}$ ounces nearly, \&c.- Again, as the ftone is fpecifically heavier than the water, it muft remain at the bottom, and can only move by rolling or gliding along, and confequently muft have fome friction from the roughnefs or tenacity of the bottom, which will increare the difficulty of moving it, and therefore diminifly the fize of the fone that can be moved with a given celerity, which is an additional confideration that muft now be taken into the account. Theory informs us, and experiments confirm the principle afferted by every writer on mechanics, that the quantity of friction is directly as the weight of the moving body, and the tenacity or roughnefs of the rubbing furfaces, let the lize of the rubbing furfaces and the velocity of the moving body be what they may, and is therefore found to be fome couftant part of the weight of the moving
 of the body; fuppofe in this cafe it were the whole weight of the body, which is very improbable, then the weight to be overcome by the force of the water would be double to what we had affigned, and confequently the diameters only half of what we had found before,

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before, and the weights only : part of the formes weights, and $f_{0}$ in any other proportion of the friction, the diameters and weights may eafily be found by our theorem.-Hence we may jufly infer, that if fones of fuch confiderable fize as we have determined above, can be driven to the diftance of 7 or 8 miles during the flood or ebb tide, that fand which is fcarce the handredth part of an inch in diameter, and its weight not the millioneth part of an ounce avoirdupois, will be carried to a much greater diftance before it be depofited in flack or fill water, or thrown up on the retired fhores, and the diftance is nearly equal to the whole run of the flood or ebb. We likewife perceive by our theorem, that a much fmaller velocity of the waters than is ufual about our bay and harbour, is competent to remove fand, and confequently to remove banks or bars, if judicioully directed or applied. Hore we might proceed to calculate the force of waves or heave of the fea, but as their force is already known to be very great in drifting fand, pebbles, fmall fones, \&rc. for the fake of brevity we decline its inveftigation, and purfue the other parts of our fubject.

The courfe of the Tides, the caufe of eddies, and counter-currents,- together with the formation of fandbanks, being heretofore in general accounted for, we are enabled the better to account more particularly for the caufe of thofe eddies and currents about the bay and harbour of Dublin, and their effects in generating the bar or other banks, and confequently to propofe the beft means of removing them, by removing the caufe of their generation.-Thus; the line of coaft

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from Bray to Rufh, being greatly incurvated and broken by headlands, iflands, bays and inlets, occafion counter-currents in Killynee-bay, Dalkey-found, hollow of the South Bull, along the South coaft of Howth, in the found of Ireland's Eye, and paft the Nofe or Head of Howth, alfo complete and contrary eddies at the green Baily; befides oppofing, receding, and jarring eddies and currents at the bar; and their velocity being in general between $1_{2}^{\prime}$ and 3 knots per hour, is of fufficient force to give motion to the fand; all which are eafily deducible from our theory and preceding Theorem: But to particularize thefe eddies and counter-currents, and to eftimate their duration and effects, is a fubject of greater expanfion than our limits will afford room, which would require all our research and knowledge of Science to inveftigate; however by the preceding principles, and the help of a good draught, or our aquaintance with the coaft, we hope to furmount the difficulty without any material diviation from what may be determined by the beft obfervations, which is the teft of every phyfical inquiry.

Having a good chart in review before us, we perceive that Bray-head, (or even Wicklow-head) Dalkey-found, Sutton Creek, Ifthmas of Howth and Portrain, are all nearly in a right line, confiderably clear of the reft of the Coaft, and exhibiting the whole Peninfula of Howth, projecting itfelf into the fea beyond any other Head-land between thefe extreme places, bearing nearly N.N.E. and S.S. W. of each other by compafs. We perceive alro that the flood tide in the offing oppofite Bray fets about N. N. E. ${ }_{2}^{1}$ E. to clear Howth Head, but when it

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arrives nearly abreaft of Dalkey, a branch of it muft neceffarily be impelled over the the Man of War road towards the Bar by the fhorteft paffage to fupply the Bay, the Harbour and the great extent of ftrands on on either fide; on its arrival at the Bar it is oppofed by the ebb-current of the Liffey, for a time proportional to the reach, declivity, and momentum of the natural land-waters of the river ; becaufe every river muft neceffarily run into the fea for a confiderable time after the flood-tide in the offing commences, or until fuch time as the river current is overpowered by the impulfive force of the accumulating flood tide in a contrary direction : the central current of flood when arrived at the bar, is again divided, the greater part it going to fupply the South-Bull Strand, and the remainder the North Bull; but the part urged towards the South Bull, and falling into the hollow thereof, muft by our theory occafion an in-fhore counter-current, along the coaft thro' Dalkeyfound, till it unites with another branch of the offingtide urged into the hollow, and forming a counter-current alfo in Killynee Bay, and their duration will continue while the caufe remains, that is until the ftrand and hollow of the South Bull and Killynee Bay are nearly half charged with the influent waters, after which, until high water, the tide having acquired greater energy by the acceffion of fo much additional water, will fet along the Coaft in the contrary direction, towards the Harbour : The remainder of the offing-tide which does not feperate abreaft of Dalkey with the central branch, continues its proper courfe for Howth Head untilit arrives at the green Baily (a great projection of land fretching due South
from the S. E. part of Howth for near half a mile) on which it impurges caufing an in-fhore weftern curtent along the South coaft of Howth, making for SuttonCreek, and Dublin Bar, where it is alfo oppofed and arrefted by the laft of the ebb-current of the Liffey until the Bay has partly filled, and the tide to pour in more rapid by the central current, to overpower the current from the Harbour, which we may eafily judge to be about the end of the firft quarter of the offing. flood, becaufe it is evident that the tides run fwifteft at half-flood and half-ebb, and floweft or almoft to be ftationary at high and low water; hence if we take a mean of the times when the flood moves quickeft and floweft, we cannot err much from the true time when it overpowers the ebb-current of the Liffey, which is about the end of the firft quarter; the waters at this time pouring in over the center of the Bay more abundantly than neceffary for the fupply of the Harbour, the North, and South Bulls, on acconnt of Howth intercepting a great body of the water in its natural courfe, by projecting fo much into the fea, beyond any other Head-land within the efficient reach of the tides. The tedundant waters which are not acceflary for faid fupply, muft pafs Eaftward along the South coaft of Howth till they arrive at the Baily, overpowering the former languid weft current while redundant waters come into the Bay, that is until high water. - The laft of the ebb from the Harbour being thus oppofed at the Bar by the central and weft currents on the firft of the offing-flood, muft wheel round the Light-houfe, and fall into the counter-current in the hollow of the South Bull, that fets fouthward along the coaf. The

The remainder of the primative tide, with which we commenced, paffing Howth head, muft be forced into Ireland's Eye-found to fupply it, together with Baldoyle frand and gut, with influent waters, fo that the current will pafs to the northward through the found, as well as on the eaft fide of the Ifland, until the found, and ftrand along the coaft are pretty well charged, fo as to form an extended Bay, between Howth head and Rufh pier, which will require a greater body of water to fupply together with the ftrands and inlets at Malahide, Turvey, \&c. than can poffibly enter northward thro' the found ; it is therefore urged inwards by the greater momentum of the deeper waters in the extended mouth of the Bay, than in the found, which will caufe an in-fhore counter-current, to the fouthward along fhore, and through the found for the remainder of the flood tide ; and this effect commences when the tide runs quickeft, and the Bay partly formed, which is about half flood, at which time the two currents meeting and oppofing each other about the north end of Ireland's Eye, they become nearly ftationary for fome time, hence by their re action, and the fubfiding of the floating fand, a ridge is formed acrofs the North entrance, which has only 9 feet on it at low water fpringtides, while the South entrance and found, has 5 fathom water in it at the fame time.

From half flood to high water, the counter-current from the found paffing the nofe of Howth, and the eaft current from the Harbour meet at the Baily, and circulate in an eddy round Rofsbeg, a bank of fand projecting W. S. W. from the Baily point, about 2 miles
long, and ${ }_{2}^{1}$ mile broad, beginning about ${ }_{4}^{{ }_{4}}$ mile from the Baily, and having 18 feet water on it at low water fpring tides.

Having thus far, which is fufficient for our purpofe proceeded with the flood tide and explained its eddies and counter-currents, we fhall return with the ebb, and in like manner account for its eddies and counter currents, at the different points of inflection which were noticed before, and then affign their united effects in generating the Bar, and other banks within our preceding limits.

The ebb current coming from the northward, butts directly againft Ireland's Eye, and Howth, and no counter-current can then poffibly happen in the found; for the fame caufe which occafioned the counter-current there on the laft half-flood ftill remains and confpires with the natural courfe of the waters during the entire of the ebb-tide, fo that the currents within the found fet to the northward for about 3 hours only of the whole tide, and to the fouthward for the remaining 9 hours. The Bay, the Harbour of Dublin, the ftrand on either fide, and their different channels being charged by the flood tide, the waters on the ebb muft principally retire over the center of the Bay, where it begins firft to fubfide, and is followed by the waters of the Harbour and either ftrand, as they fucceffively defcend, the courfe of the central ebb current being in a direct contrary direction to the former central flood current, while the infhore current from Killynee Bay and Dalkey found preferves the courfe it acquired from half-llood, which is now a counter-current, falling into the hollow of the

South-bull, and winding round by the Light-houfe'till it unites and paffes along with the central current, making for the general ebb abreaft of Dalkey; but the waters fubfiding from the N. Bull and Sutton Creek, pafs eaftward along the S. coaft of Howth, till they arrive at and fall in with, (oppofite the Baily) the ebb current fetting fouthward paft Howth-head; for the interior waters in the harbour, and on thofe extended flrands being more elevated on the flood, as appears by our theory, than the exterior water in the Bay, muft by their gravity prefs upon and follow the exterior retiring water, until the in-fhore water becomes nearly level with that in the offing paffing Howth, which muft take place after halfebb, or rather about the beginning of laft quarter, when on account of the greater momentum of deeper water, the interior fhoal water is preffed or impelled inwards, overpowering and changing the direction of the former currents, viz. the eaft and central currents to weft currents on each fide of Rofsbeg, fetting for the Bar, where they are met by the current from the Harbour, and after their collifion unite and pafs fouthward along the coaft, contrary to the counter-current, which will continue fo, during the remainder or laft quarterebb. - We may now recapitulate the total fetting and duration of thefe feveral currents and eddies in their refpective places; for a whole tide, or that of both the flood and ebb-tides in the offing, to be fouthward along the coaft through Dalkey found, during the laft quarter-ebb and the firft half flood, and northward for the remaining five quarters, that is from the firft of half flood to the lait of three quarters-ebb nearly ; the central current making for the Bar, from the third quarter ebb to high
water, and its return by the center of the Bay during the first three-qurrters-ebb; the eaft current along Howth continues from the first quarter-flood to the laft quarter-ebb, and the weft current from the last quar-ter-ebb to the fecond quarter-flood : lastly, the eddy current at the Baily circulates round Rosbeg, from half-flood to high-water. - Hence we clearly comprehend the immediate reason why the Bar and other banks about the Bay and Harbour of Dublin are formed and maintained. The opposing currents from the third quarter-ebb to the second quarter-flood, and the receding currents from the first quarter-flood to high water, will occafion the sand to be thrown up and heaped at bottom, and the floating sand to subside, and on both accounts must generate the Bar to a given height, which is deeper toward the South Buoy, where the currents conspire most in each other's directions; -The complete circular eddy at Rosbeg, forms that bank. - The indraught into Killynee Bay, forms a ridge towards the fouth end of Dalkey Ifland.The South Bull being now protected by the fouth wall or rampart, must be driven inwards and accumulate by every heave or fend of the fea from the S. E. quarter, and confequently the fouth end of the Bar and the fouth Charnel must flift inwards clofer to the South Bull, which is now more incurvated and steeper along its edge than formerly before the wall was built; in like manner the formation of the ford and patches in the Harbour, Burford, and Bennet's banks outfide the Bay, the Kish, and other banks called the Irish grounds, \&sc. might be accounted for, but the cause

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of the Bar, is our first object which may be confidered under another point of view; thus, were there no river ; then the N. and S. Bull's would only be one continued bank or strand formed both by flood and ebb-tides, and by every fend of the fea from the eaftward; but there being a river it must find a paffage, and when the force of its current is nearly balanced by the force or refistance of the fea from without inertly oppofing, or actively fetting againft it, muft generate the Bar so often fpoken of, and fo injurious to the trade of the metropolis.- The fand on the Bar is more compact and constipated than on either Bull, by the continual agitatition of the water over it ; so in the fand on both strands within the limits of the recurrence of the waves more constipated than elfewhere about the bay.

The preceding principles and reafoning being premised and duly confidered, will qualify us to form a right judgment of the merits of the plan, we are at length prepared to propofe for the imprevement of Dublin Harbour, which is, to convert the Peninfula of Howth into an I/ and, by cutting a large canal acrofs the ifthmus near the green fields, to be continued both ways to Sut-ton-creek, and Baldoyle-gut, which would change a great part of the prefent ifthmus into a found, calling it the Sound of Howth.

If Howth were an Illand, having deep water in the found and the bar, the North Bull and the ftrands on both fides the prefent Ifhmus removed, with good anchorage for large Veffels all round Howth, and Ireland's Eye fheltered from every wind without the terrors of the North Bull or bar to encounter, the valt importance
to the trade and profperity of the city, and the prefervation of great number of valuable lives would be evident to every confiderate perfon; but what Nature has almoft completed let Art accomplifh, denouncing the total extinction of the fatal North-Bull and Bar, by infulating Howth, and affifting Nature to procure us a fafe harbour free of obftacles to its entrance, which may be effected at a finall expence compared to the great and important advantages that muft neceffarily be obtained by adopting our plan.

Let us now enquire into the confequences of our project were it adopted; it is plain that inftead of thofe jarring conflicts at the Bar, North-Bull, and Northfound of Ireland's Eye, the flood currents would confpire together and rufh violently through the found of Howth, fcouring the Bar, North Bull, and Baldoyle Banks, and depofiting their contents in the wake on the fhores of Malahide, Portrain, \&c. but no part of this drifted fand can fubfide on the fhores of Howth, Ireland's Eye, or in the North entrance to Ireland's Eye found; becaufe the flood-tide which comes round Howth Head and falls into the found, confpires with the current paffing through Howth found to difcharge the drifted fand far beyond thefe places; for if ftones of great a fize as ${ }_{6}^{5}$ of an Inch in diameter, and near 4 of an ounce in weight, as appears by the folution of our problem, can be driven to the diftance of feven or eight miles during the flood or ebb tide, when it moves at the rate of three Knots, that fand which is of fmall magnitude, and not the millionth part of an ounce weight, muft be driven in vaft quantities to a great diftance before it is depofited

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on the fhores, or in flack or ftill water, tho' the current through Howth found were even much lefs than ufual in fuch places; befides the flood-tide having paffed through the found, will fpread itfelf with fufficient force to clear away in a great meafure the fand which lies to the weftward of the Pier and abreaft of Howth Town; and the middle current will deepen the North entrance to Ireland's Eye-found by removing the caufe of the counter current on the laft of the flood, which at moft is very languid or nearly ftationary, the defect of influent water through the fouth entrance to fupply Baldoyle ftrand that occafions the counter current, being then abundantly obtained directly in its natural courfe, through the found of Howth, -This plan will likewife greatly diminifh the eddy current at the Baily, as the redundant waters will moftly pafs through the found of Howth, and confequently diminifh Rofs-beg bank, by lefsening the caufe of its formation.

Thus have we purfued the flood-tide through our propofed plan, and found every good effect that could be defired, without a fingle evil one to encounter.-Let us in like manner inquire what the confequence of the ebbtide would be.

The current coming from the northward through the found of Lambay makes directly for the found of Howth for the entire ebb, and as it cannot all enter at once, it muft divide, part of it wafhing the Northern Shore of Howth, and weftward of the Pier, ftretching towards Howth-head, bearing with it all the fand wafhed from the aforefaid places, which it muft carry to a great diftance fouthward of the Bay of Dublin to flack water banks,
banks, eddies or fhelving fhores; but not a particle depofited on either Bulls or Bar for there would then be no weft current fetting round Howth towards the bar, this part being fupplied by the ebb-current through Howthfound. - Thus we fee that what the flood-tide would leave undone towards cleanfing the northern Coaft of Howth, this part of the ebbtide would finally accomplifh. The other part of the ebb-tide which makes for the found of Howth, violently rufhes through, beeaufe the found is more contracted than either extremity ; and becaufe Howth projecting fo much into the fea beyond the line of Coaft, imbraces a vaft body of water in rapid motion making for the found, hurrying with it the fand and gravel of Baldoyle banks, the North bull, and the Bar, clear of the harbour; or to the fouthward of the Light Houre, the velocity of the current being more than fufficient for thefe purpofes, as appears from the folution of our problem to which we refer, flowing that large pebbles may be driven to the diftance of 7 or 8 miles when the velocity of the ftream is only at the rate of three Knots, and confequently fand to a much greater diftance, were the velocity even confiderably lefs: than can happen in the found of Howth, which would at leaft be equal, if not for very good reafons much greater than the Race of Dalkey, whofe rapidity is fully competent to effect all the purpofes afcribed to our plan were it adopted; befides none of the drifted fand can be depofited on Howth fide, becaufe no part of it has flack water, but ftrongly brufhed by the ebb-current, except Candleftick-bay to the weftward of the green Baily, but any fand left their on the flack of ebb-tide, would
be carried away the next flood, acting direetly againft it. Again, no fand can poffibly fubfide in the harbour mouth or on the baf, becaufe the ebb-current of the river acting latterly on it would completely confpire with the ebb current of the found by their conjoined force to carry the fand quite to the fouthward of the bar and LightHoufe into ftill water, or thrown up on the South bull, being the neareft retired ftrand or fhore; it is evident that the river would clear its own paffage, and the current of the found would be fufficently rapid until it paffed the Harbour for fome diftance fouthward of the Light-houie, as may be inferred alfo from the folution of our problem. And here, as in the flood-tide, every good that could be wifhed for would be effected without the fhadow of one the leaft injurious.

We have reafoned all along about the confequences of one flood and one ebb-tide on the completion of our plan, and found thefe banks fo often mentioned to be partly carried away and depofited where they could do no manner of injury;-Hence by a fucceffion of thofe tides the whole of thefe banks would be carried away in a fhort time were our plan adopted, and confequently obtain a fafe and excellent harbour for the depth of water, free of any obstacles ot its entrance, thofe which now exist being then removed, befides a fpacious road ftead in the prefent fide of the North Bull and Strand, in the found of Ireland's Eye, and every where round the Ifland of Howth, having good anchorage and well fheltered from every wind.—But as we came to this general conclufion by a long train of clofe phyfical reafoning, it might be more agreeable to fome Gentlemen
to come to the fame thing by an eafier method founded on facts and common experience which may be stated; thus:--It is a matter of fact and common obfervation, that a frall Ifland fituated in the race of the tides at a flort distance from the main or projecting coaft, has always a deep found, and fleep fhores both towards the main land and the Ifland; but the cafe is different when the Ifland is fituated clofe to the fhore in the hollow of a deep Bay out of the race of the currents of flood and ebb , for the ftream would be lefs rapid in the latter found than outfide the Illand, aud corfequently the fand would be thrown up into the flack water of the retired found which in time would completely fill it.-And among the many instances we could adduce for the proof of the first cafe, we need only refer to thofe more immediately at hand, to wit, Dalkey Ifland, Ireland's Eye, Lambey and St. Patrick's Illand, but more particularly Dalkey Illand, which would be exactly in point were there a river emptying itfelf into Killynee Bay, at a fmall distance fouthward of the fouthern head-land of Dalkey main, which inftead of injuring the entrance at the found, would greatly confpire with the flood and ebb-tides to deepen it, by increafing the currents, neither could there be any bank or bar throwh up oppofite the river, for any fand brought down the river and falling into the crofs current through the found, would be fwept away by its rapidity, as there never would be any flill or oppofing water to permit the fand to fettle near the mouth of the river : now if Howth was an Ifland the cafe would be exactly fimilar to this of Dalkey, and the like confequences would naturally follow,
that is, leave a clear Harbour free of Bar or banks, a thing fo defirable at the port of Dublin.

St. Patrick's ifland, oppofite the fmall Town of Skerries, is alfo in many refpects fimilar in fituation to Howth if converted into an Ifland, the Saint having firft landed there on his arrival in Ireland, the natives had a church built on the iffand under his immediate direction which they dedicated to him, and then ferved as a place of worfhip for the inhabitants of the main-land, the ifland at that time being feperated from the main by a very finall fream of water and that only at fpring-tides which could not then prevent their devotional duties, being accefsable on foot of which they were not over fcrupulous of wetting, but the interval is now impaffable at the loweft ebb, on which account the facred pile has been fuffered to fall to ruins, to fupply which the inhabitants of Skirries have built a new church on the main-land which they call St. Patrick's new church : here we have direct proof by analogy what would be the confequence of affifting nature in making Howth an ifland, as it lies more in - the race of the tides way, and imbraces a much greater body of water than St. Patrick's ifland, which was once joined to the main but now feperated by a very deep channel or found, by the rapidity of the currents of flood and ebb without the affistance of art.

Oppofite Dunmore-head, (the moft western point of all Europe, called Mary Gurnane's boufe, a point as much celebrated as Jobn of Groot's houfe, which is the utmoft extremity of North-Britain, ) lie the Blaskett's or Feriter's Illands, being twelve in number, derived
from the word Blaosc (or Blaosg,) which fignafies in Irifh fcale or fhell, faid to have been fcaled of the main-land: on the great Blaket one of thefe illands, faid by tradition to have been formerly joined to the continent, the counrry people as a proof thew the remains of an old ditch which they fay points to an oppofite one at Dunmore that were once joined; there is the ruins of a very antient church on it, and the found between it and the main-land is of great depth, the currents of flood and ebb are capable of producing great effects, fetting through it with prodigious force and velocity : but it is needlefs to multiply inftances of the powerful effects of waves or rapid currents in producing caverns, natural fountains, or converting Peninfula's into Iflands, \&c. as they come under the obfervation of any perfon who does not Thut his eyes againft facts, nor fcruple to ftudy the natural hiftory of his own country.

We mult however obferve, that the antient Irifh were wont to confiruct large inclofures of ftone called Bazun's, built as places of Arength or fortification, to prevent their cattle being carried away by the Wolves, or their more rapacious neighbours, and to which feveral clans would retreat upon a fudden irruption of fome powerfal enemy, and were formerly the only appendages to great men's caftles, near to which they alfo built their churches, that in cafe of hoftilities they might perform their religious ceremonies without being molefted, as it could eafily be defended by a fmall number of men; but along the coaft every little Pe ninfula prefented itfelf to them as a moft complete

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Bawn formed by nature, and of greater frength than could be conftructed by art ; ——Hence we fee the reafon why almoft every fmall ifland along the coaft, is graced with the ruins of fome antient church or other venerable pile of building, which are ftrong proofs of their being formerly Peninfula's, but moftly lying in the race of the currents have been feperated from the main in the courfe of a long feries of years, and the buildings fuffered to fall to ruins, for the fame reafon as that on St. Patrick's Illand; for to what purpofe could thefe great ftructures be erected on fuch fmall barren iflands, many of them not affording frefh water, much lefs the other neceffaries of life to any great concourfe of people, if there were no other communication with the main-land than the fmall wicker boats called Cott's ufed by our anceftors, which could not anfwer the purpofe of ferrying over rapid currents fuch numbers as reforted thither.-We would infer from all this that Dalkey Ifland, Ireland's Eye, St. Patrick's Ifland, \&c. were formerly Peninfula's, as they refpectively exhibit the criterions of Irifh Bawn's, and feperated fince only by the violence of the fea and the currents of flood and ebb-kides, and as they all have deep water round them, fo would Howth were it infulated, becaufe it lies even more in the race of the currents, and imbraces a greater quantity of water, that would pafs through the found with great rapidity, which we doubt not will one day or other be the cafe, unlefs prevented by rampart walls, as the Ifthmus is a very narrow low neck of land, compofed of fand, earth, and fmall pebbles eafily removed, but

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that happy event for the metropolis and kingdom in general may be too diftant to be of any fervice to the prefent generation, unlefs the exertions of nature be rendered more effectual by the affiftance of art.

That fome harbours and channels that were once navigable, may now be entirely choaked by the fortuitous alteration of the currents is equally manifeft, as fhewn before from principles; and here we might inftance feveral fuch places, but it is fufficient to mention only fome of them, as the Harbour of Cloghnakilty, once navigable for the largeft veffels, is now to obftructed with fand that only boats and fmall floops can come to Timologue, about two miles from the harbour mouth ;-Rofs-carbery is another Harbour, which according to Camden, was formerly navigable for large flips, but these many years is fo choaked with fand, that no veffel can come to the town ; the inference we would draw here is, that as thefe and many other inftances of filling up, happen out of the race of the currents, they exhibit collateral proofs that if Howth, which lies in the race of the currents, were infulated, its found would never fill up, but on the contrary would conftantly be deepening, till it come to its limit, without bar to its entrance or bank any where round the ifland.

We may alfo collect from facts, what we had before infered from principles, that what is wafhed from the coaft in one place by the violence of the fea, is depofited in fome other place, or while the fea is making encroachments on fome fhores, the fhores of fome other place are reclaiming from the fea:-The large ex-

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tended ftrand at Youghal, whofe Bay butts direetly againft the fea, was certainly an encroachment of the fea, its violence breaking down the ancient barriers and overflowing the lower ground, for this ftrand as far as the loweft ebb uncovers it, and probably much farther, is no other than a common turf-bog, with a thin covering of fand, from whence not only good turf is cut annually, but great timber-trees, fuch as Fir, Hazel, \&c. are found in great plenty in it:- The fkeleton of a monftrous animal was alfo discovered here fome years ago, one of whofe fhoulder-blades weighed above one hundred weight:-This bog was entirely divefted of its covering of fand and gravel fome years fince by violent high winds agitating the fea to an uncommon degree, when great quantities of the ftumps and roots of large trees lay expofed to view, until they were again covered by the fand brought from the adjacent coaft, or wafhed in from the fea, for as the form was very great, the recurrence of the waves extended a great way, 'till they met the currents of the tides, which totally carried away the covering of fand, fo that the fubfequent covering mult be brought from fome foreign place; numberlefs other inftances might be adduced to fhew the great encroachments of the fea, and as many infances of the great quantities of land reclaimed from it, as at Cork, Dublin, Manorcunningham, Cloghnakilty, Rofs-carbery, \&c.

The frand on both fides the Ifthmus of Howth, is undoubtedly caufed by fuch encroachments which is ftill gaining on the land, as may be perceived by the banks

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banks frequently falling in, by the workings of the fea, tho' not in fo great a degree as it might have done formerly, for the waves coming over a great extend of frand before it reaches the banks, their violence and confequently their effects muft be greatly diminifhed from what they were before the ftrand became of fo great an extent ; but if Howth were infulated thefe encroachments would be compenfated by vaft tracts of land reclaimed from the fea, by the great quantity of sand drifted through the found from the Bar, North Bull and both ftrands, which would be depofited on the retired diftant fhores that lie out of the race of the currents, but not a particle could fubfide in the race of the found, about any part of the Island, or in the mouth of the Harbour, as there never would be any ftill or eddy water while the fand were afloat, to permit it to fettle in any of thefe places. ${ }^{2}$ Several other arguments to inforce the expediency of adopting our plan for the improvement of Dublin Harbour might here be introduced; but as they eafily may occur to thofe who have attentively perufed the preceding ones, we think the recital of them needlefs at prefent; we fhall therefore make a few remarks only on the practicability of executing our defign by the leaft expenfive method, and then humbly fubmit the truth of our reafoning, and the juftnefs of our conclufions, to the decifion of the more experienced engineer, and to the greater penetration and fagacity of thofe Gentlemen whofe duty it is to inquire into the merits thereof.

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The Ifthmus of Howth, is only about 400 yards broad in the narroweft part or the middle of the propofed found, is a very low neck of land not more than four feet above high water-mark; is compofed of fine loofe fand and earth, without either rocks, ftones, or quarry interfperfed therein; the ftrand and banks on both fides the Ifthmus, have been bored to a great depth, on account of other inquires, and is faid to contain a clayey bottom all along from DublinBar to the North entrance of Ireland's Eye-found, at the depth of between five and fix fathoms under low water-mark :-There is indeed on Howth fide of the Ifthmus a lime-ftone quarry eafily worked with the crow or pick, but we are informed by the workmen that it does not extend near our propofed found; as the men affured us that in following the veins of ftone, they find them terminate, or as they call it run out, before they come near the low narrow part of the neck of Howth ; now fhould our project be approved of, and the truth of the above circumftances appear upon a fpecial and more particular examination of the facts, then the expence of executing our defign, compared to the advantages expected to be derived from it, would amount only to a mere trifle.

Several frugal methods to fave expenfe will here prefent themfelves, as prudence, varying circumftances, or the nature of things may require ; fuppofe the following for example. Let a canal of ordinary breadth, but of a good depth, for inflance five or fix fathoms, be cut nearly acrofs the ifthmus in the middle of intended found (the execution of which will either confirm or invalidate
the truth of moft of the foregoing particulars) and the excavated earth and fand thrown on the banks; then, if there appear neither rocks nor quarries to the further hindrance of completing the work, cut a channel pretty deep from each end of the canal, as far on each ftrand as thought neceffary, and boldly open both ends of the canal, thro' which the water will rufh with aftonifhing rapidity (except on the flack of the tide) bearing away great quantities of earth, fand, gravel, \&c. which in time would complete the found and entrance on both fides over the ftrands to a fufficient breadth and depth, for large veffels to pafs at any time of tide, and convert the prefent fite of the North-bull and ftrands into a fafe and fpacious roadftead, \&c. But here Nature muft be afsifted to haften her operations for more immediate advantage to the community, by employing a number of men and boys to root up the fand and gravel of both ftrands, as far as they can advance when the tide is out, the conterts of which they may throw up on both fides of the channel, or gut, which lead to both ends of the canal; but when they cannot work on the ftrands from the depth of water, let them be employed (about halftide when it runs moft rapid) throwing the banks into the found, as if they intended to fill it up again, only fcattering the earth and fand as much as pofsible, which inftead of fubfiding would be hurried away by the rapidity of the current as fast as they could difcharge it, without any danger of filling up the canal any more than they could fill up the found of Dalkey by fuch means, which every one knows would be abfurd to immagine. Now, by purfuing the fame round, the canal and chan-

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nels would foon be rendered fufficiently wide (which we think ought to be a quarter of a mile at leaft) and when the labourers are prevented, by realon of under-water, from defcending farther on both ftrands, the following contrivance may be ufed, viz. to employ a number of finall craft fuch as fifhing boats and wherries, letting, them drift thro' thofe channels and canal when the tide is rapid, trailing after them a machine like a large iron harrow with fhort teeth, or another of a cylindrical form called by mariners a Porcupine, to root up the fand and gravel, \&c. that they might the fooner and eafier be carried away by the current. Thefe machines fhould afterwards be ufed to accelerate the removal of the Bar, N. Bull and other banks.-Hence our plan is the beft external improvement of Dublin harbour for the prefervation of Life and Property; requires the leaft expenfe to execute, and no additional expenfe to perpetuate; it is founded on the immutable Laws of Nature, and therefore the moft rational. Without infulating Howth every other project for improving the harbour, would only he partial, of little avail to benefit fociety; and fome of them might even be injurious; as we are confident the North-bull would ftill protrude his horns, to gore the vitals of the commerce of the metropolis of the kingdom.

Should our plan be adopted, it might be thought neceffary, at leaft for fome time, to preferve the communication between Howth and the main land, by building a fubftantial wooden paffage on piles over the Sound, having one or more draw-bridges near the cen-
ter, which might be confructed on fuch fimple principles, by means of equipoife acting as a balance on its fulcrum, to open and fhut with vaftly greater expedition and eafe than ufual.

Thus have we fhewn how a fafe harbour may be obtained at the port of Dublin, free of impediments to its entrance, by only afsifting Nature in her operations, and promoting her effects; and having already exceeded our intended limits in the difcufsion, we fhall for the prefent difmifs the fubjeet, only with this remark, that we regret the mifapplication of the genius of thofe projectors who are continually torturing Nature to fuit their plans, inftead of accomodating their plans to the Laws of Nature, and the effects of her operations; here we beg to be underfood, that tho' we ftrongly recommend our own plan, we mean not to depreciate or be thought the arbiters of any other, afsigning that bufinefs to the proper judges; but that every improvement of the harbour of Dublin which convenience, and the nature of things require for the public good, may fpeedily be accomplifhed, is the hearty defire of.

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To the Rigbt Hon. and Hon. the Directors General of Inland Navigation.

## Gentlemen.

YOUR Letter of the 22nd ultimo. to the Governors and officers of the Marine School, defiring their refpective obfervations and opinions of the different plans for the improvement of Dublin Harbour, a copy of which you were pleafed to fend them; I had the honour of laying before the Committee of the fociety, as early as poffible, on Monday the 11th; But, befides that part of my duty, I conceive myfelf bound, through the refpect I hold to the Directors General and the public, to offer fuck additional remarks, on the moft effectual method of improving the Harbour, as occured to me fince I had the honor of fubmitting my plan to your confideration, together with the reafons of my objections to the different other plans.-Opinions on public concerns, efpecially in what relates to fcience or art, fhould be difcuffed with the utmoft freedom, as they are fubject matter of inquiry for found intelects, or good underftanding, with deference only to good breeding and clofe inveftigation.- I thall proceed therefore without farther apology, only beg leave to premife a few propofitions founded on philofophical experiments, and the obfervations of the moft intiligent philofophical Engineers, as lammata or principles in our prefent refearches.

If Position. Rivers, (or canals) of fufficient length, acquire train by their declivity and the refiftance of their borders, that is at laft move with an equable velocity.And their beds and fides obtain a regimen or ftability of dimenfions, fuited to the tenacity of the foil, and celerity of the ftream.

2nd Position. I calculated in my former addrefs (which I believe to be firft of the kind) the effect of water moving with a given velocity in a given bed, which I am happy to find, is fince confirmed by the moft palpable obfervations of the ftricteft obfervers of nature's general procudure in thefe cafes; viz. that water moving with the celerity of 3 inches per fecond at the bottom, will juft begin to work upon fine clay fit for pottery, and however firm and compact it may be, it will tear it up in time, tho' no beds are more ftable than clay, when the velocites do not exceed this; A velocity of 6 inches per fecond will lift fine fand; 8 inches per fecond will drift fand as coarfe as flaxfeed; 12 inches per fecond, will fweep away fine gravel; 24 inches per fecond will roll away rounded pebbles an inch diameter; and 3 feet or 36 inches per fecond at bottom, will fweep along thivery angular ftones of the fize of an hen's egg.

3rd Position. It is a natural phenomenon in the progrefs of rivers, that their mouths expand themfelves fomewhat in the form of a bell or trumpet, or rather that formed by the revolution of an elongated trochoid round its axis ; we would venture to affert, that double the quantity of water might be difcharged from the fame head, and thro' the fame channel in a given time, the water running in train, by giving the entry a proper form, than could otherwife be done; or that we could increafe the heights of the tides up the river fome feet, by properly adjufting the form of entrance to the hydraulic ofcillatory reach of the river.- The inveftigation of the nature of the curve forming the entrance, is extremely difficult,

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and involves all our knowledge of hydraulics which is unneceflary here, as we proceed on facts and experiments, the teft of every phyfical calculus, the proportions in the leaft whole numbers being found as 3. 4. 8. ie the diameter at the gorge 3. at the mouth 4. and the diftance of the diameters 8 . or any multiples of thefe dimenfions in given meafures.

4th Pos. A permanent river will rife, if it receives any addition, and the fquares of the difcharges are nearly as the cubes of the heights; but the velocities ate nearly in the fubduplicate ratio of the difcharges, a principle in hydraulics eafily deduced from theory, and confirmed by numerous experiments.

5th Pos. Another curious and ufeful principle of information, fuited to our prefent purpofe, and founded only on experiments is, that the difference between the fuperficial and bottom velocities of any ftream, that is, in train is proportional to the fquare-root of the fuperficial velocity :-Alfo, if from the fquare-root of the fuperficial velocity in inches, you take one, or unity, and fquare the remainder, you will have the bottom velocity, and the medium velocity is half the fum of thefe two; - The medium velocity regulates the train, the difcharge, the effect on Machines, and all the important consequences of the motion of waters.

6th Pos. A paffing tide, or crofs current, at the mouth of any river, prevents bars or banks at its entrance, if the ebb-current of the river falls in with the paffing ftream into deep water;-But rivers not circumftanced fo, will produce fhoals, banks, or bars, and fometimes iflands; the reafon is clear, and I imagine the principle fully eftablifhed in my former addrefs.- No river can be fairly urged as an exception; but all we know of advanced in confirmation of it, it is an immutable law of nature, and evident to the moft common obferver ; I never knew any one hardy enough to contradict it.

7th Pos. Water in a canal runs only in confequence of the declivity of its lurface; but it is quite otherwife in a river which ebbs and flows. - The tide after flowing fome time, coming to the mouth of a river with greater force than that of the current of the river, (on account of the greater quantity of motion of the flood from the energy of deep waters,) muft not only check the river's velocity at its mouth, but give it motion for a fmall distance in the oppofite direction of the current, and confequently accumulate the waters between thefe points, and therefore rife higher than at the point of congrefs. Now from a continual fucceflion of thefe impreffions the water in the river will accumulate more and more, and with greater heights, to greater and greater diftances from faid point of concourfe, while the influent water urges forwards at bottom, making the whole to move that way, affifted by the hydroftalical preffure, until the water may at laft raife to a very great height above the level of the fea at the mouth of the river, fuited to the form of the entrance, and difference of the productive heads of the tides and river velocities; -For the fame reafon, the water may fubfide in the river greatly below the level of the fea, and yet preferve a current of reflux ; the hydraulic reaches and heights of coexistant high or low waters of different rivers above or below their mouths, are matters of curious and extreme ufeful information to the civil engineer, required to improve harbours ; and did this place require it, we would detail the inveftigation;-Obfervations however fhew that at $A n^{-}$ nappolis-royal the tide rifes above 100 feet. At. St. Malow 50 feet. At Bristol 4.5 feet, \&c. and at Carlife-bridge Dublin 12 feet at leaft, (by my own obfervations) above the level of the fea, at the mouth of the river. In the fame mannier the depths below faid level are various in different places on the ebb ; the fubftance of this I gave in other words in my former addrefs.

We fhall now proceed in the application of thefe principles to the objections we have to make to the plans before

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fore us, and the confirmation of the eligibility of our own, with fuch additional remarks as may occur to ns in the difquifition.

The difficulty conceived of improving the prefent harbour of Dublin, occafioned the many plans for building detached dry harbours pier-heads, rampart-walls, and fhip canals for the convenience of its trade; but until it appears that the prefent harbour cannot be improved, or unlefs the expence be greater than fuch additional works require, I conceive it prudent to direct our whole attention to the improvement of the channel of the Liffey, and the more eafy accefs to its entrance. I have little to add to the well grounded objections of Capt. Bligh, and Mr . Rennie, to fuch detached works, unlefs the remark of a very learned and experienced naval officer, extremely well acquainted with the bay and harbour, who was defired feveral years fince by the then Lord Leiutenant, to examine along the fouthern coaft of the bay, and to report whether, or if any harbour of general ufe to the trade of the city, could be conftructed in that quarter; and having executed his orders, gave it as his opinion" That any attempt to convert Dalkey-found, Dunleary, \&c. into a harbour for fhips of burden, trading to or from the metropolis, would only be a lure to the hazard of the lofs of more lives and property than could otherwife happen." In confequence of which report, the project was difcountenanced.

I am convinced that continuing the North-wall of the Liffey to the Spit of the North-bull, having a proper form at its termination, fuited to the reach, flope, and capacity of the river, would be of great advantage to its navigation, when confined to its own proper form ; but any openings permitting the water to fpread over Clon-tarf-ftrand, would be like fo many breaches in the wall; and not only the fame confequences would follow, of velfels being hurled through them, as in the breach which happened a few years fince in the South-wall, but probably

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bably worfe, the lofs of many lives, the injury of the channel, and the diminution of the rife of the tides in the river.-Again, if Ballybough river be not difcharged into the Liffey, but made to run along the back of the propofed North-wall, it would greatly injure the wall, efpecially in frefhes, unlefs the wall be extremely well backed; it is therefore advifable and probably lefs expenfive as well as more advantageous to the public, that Ballybough river be confined to its own bed between parallel walls, to empty into the Liffey in the direction, and clofe to the N . wall of the lots, and by deepening its channel may be made navigabl to the bridge, its stream would be of fervice to the Liffey; befides the whole ftrand of Clontarf would fooner be reclaimed, by the great quantities of fand thrown in behind the wall on the flux, and depofited on the reflux of the fea, thefe depofitions may be greatly promoted by placing bundles of furz, \&c. at proper intervals on the ftrand, fecured by ftones attached to them, to be fhifted at pleafure, the certainty of which effect I have fnlly proved in my former addrefs, or may be eafily inferred from the 7 th Pos. The project for conftructing an embankment, from the Spit-bouy to Clontarf, even according to the corrected plan, I imagine to be liable to many objections; for tho' the narrowing of the mouth of the harbour would undoubtedly occafion a very rapid current there, and confequently greatly deepen the entrance, yet the other effects would be quite contrary to what the plan purpofes, the flood-tide coming to the mouth of the harbour, with a given momentum its velocity muft be increafed as you diminifh the entrance, until you arrive at a certain width where the velocity is a maximum, after which diminifhing the width would diminifh the velocity, the limit is a matter of curious and ufeful inveftigation, with which we may difpence at prefent, as we are certain the propofed width would greatly accelerate the motion of the flood, confequently difturb and carry in with it, a great quantity of fand, \&c. And as the water in fupplying the river muft fpread itfelf over the

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whole of Clontarf ftrand, \&c. the velocity of every fection within the gorge or entrance muft be diminifhed, and confequently moft of the fand brought in would be depofited at fome diftance within the entrance, and there form a Jecond bar as deftructive, or more fo, than the prefent one. Nor would the ebb-tide have any of the fcouring property with which they flatter themfelves. - The flood-tide arriving at the mouths of rivers acts at the bottom, forcing in underneath, while the waters are heaping at top, until by a fucceffion of impreffions, they are all urged in the fame direction; but the ebb-tide begins by fubfiding of the waters at top, and this fubfiding is fucceflively communicated from the mouth along the river until the whole begins to ebb; therefore the current of flood in a level canal, communicating with the fea would be greater at bottom, and of greater continuance than that of the ebb; fo that unlefs the natural current of rivers compenfated for the difference of velocities of the flood and ebb-tides at bottom, they would foon be choaked, and rendered unfit for navigation fee, Pos. 7. now as the natural current of the Liffey does not feem competent to this defference, fhould the embankment from the Spit-buoy to Clontarf be executed, worfe confequences are likely to happen than we encounter at prefent.

It is afferted in the plan, that by narrowing the mouth of the harbour, it would increafe the quantity and height of the flood-tide, and by widening, proportionally diminifh it, tho' the inner breadth be continued as at prefent; the contrary of which would be the abfolute fact, as may be perceived from what I have already faid, efpecially in the 3 rdPofition, -Befides, fhould the entrance be fo contracted, and afterwards the waters be permitted to fpread over fo great a ftrand as Clontarf, there would be fo prodigious a joggle of fea at the Pier-heads, as would render it morally impofible for a vefsel of burthen, with any degree of prudence or fafety, to attempt entering the harbour in a gale of wind.

I am alfo perfuaded that fuch a plan would greatly injure the rife of the tides in the river, as may alfo be feen by the $3 r d$ Pofition;-And that it could have no effect in deepening the bar, is fufficiently proved by Mr. Rennie, but more clearly by Pofition the $6 t h$.

By compairing Sir Thomas Page's eftimate for building the North-wall, viz. f. 168000 , and Capt. Cornel$l y$ 's, for building the imbankment from the Spit-buoy to Clontarf, viz. \&. 174240, it appears that the former is much lefs expenfive than the latter, tho' the wall be much the longer of the two ; the wall being in the run of the ftream would require lefs labour, materials, \&c. in the execution than the imbankment, which muft lie acrofs, and oppofe fo vaft a body of water as daily fets in, over, and round the Bull, and that frequently with immenfe violence; at all events the continuance of the North-wall would be a certain improvement of the harbour, and the imbankment from the Spit-buoy to Clontarf at beft, but a very uncertain one.

The plan for continuing the South-pier as far as the bar, and building another, from the Spit-buoy as far alfo, would undoubtedly deepen the prefent bar, but it is equally evident it would occafion another bar at about a quarter of a mile to the Eaftward of the Pier-heads, as deftructive as the prefent one, and probably more fo. Indeed the Gentleman himfelf has candidly acknowledged, that little advantage could be derived to the harbour', tho' the expence of executing the different works he propofed would be immenfe, a fufficient objection to the whole.

Other plans are fo many and different, that it would require a volume to comment on them feverally; but one obfervation applies to them in general, that the projectors refpectively fhift and change them at pleafure, or propofe new ones as they meet objections to the old; 2 proof that they have been too haftily formed, or fo ill digefted, that the propofers therafelves do not approve of any of them,

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Nothing could induce me to be thus free in my remarks, but the importance of the fubject, and my defire for the public wellfare.-I fhall now offer a few hints for improving, cleanfing, and deepening the River itfelf, \&c. in addition to my plan for improving the harbour.

The ufual ftream of the Liffey is thought too inconfiderable to preferve fability at a fufficient depth, to keep vefsels of burthen afloat at low water, or to fcour the river of the filth of the city and deepen the channel; continual dredging, with a proper number of lighters, may lefsen, but never can wholly remove the evil ; natural means, afsifted by art, only can remedy it; we fhould therefore look towards the fource along the river, and fee whether any other rivers, brooks, ftreams or rivulets, can be turned into the courfe of the Liffey at a moderate expence to encreafe its waters; if we can confiderably increafe it, we fhall in time have all the advantages of a clean river and deep channel.-I am not fo well acquainted along the Liffey to its fource, as to be able to fay whether fuch additions can be made, but if it can, the inhabitants along the courfe of the river, need not be in the leaft dread that it would overflow its banks, tho' the waters be encreafed to double or triple the ufual difcharge; for it appears by the $4 t \mathrm{~h}$ pofition, that the heights are in a lefs ratio than the difcharges, and the velocities in a much lefs ratio:-About the year 1600, the waters of the Panaro, a very confiderable river in Italy were added to the Po, which greatly improved its navigation, but the project of uniting the Rhenno, another great river to the $P o$, $f o$ alarmed the inhabitants of the valleys adjacent, as to become the fubject of near 100 years litigation, until 1720 when their fears were overcome, and the junction of thefe great rivers effected, fince which the Po has greatly deepened its channel with prodigious advantage to its navigation, draining extenfive marfhes which lay for ages under water, and lefsening the danger of overflowing
flowing its banks in time of frefhes. - Many other inftances we could adduce of the great advantage to navigation by the junction of rivers, but the principle is too evident to require much elucidation.

The current of the channel of the Liffey, I fuppofe on a medium to be at leaft 2 knots, that is abour $3 \frac{1}{3}$ feet, or 40 inches per fecond; naw by the $2 n d$ Pofition, it is plain that this velocity is confiderably more than fufficient to cleanfe the river and preferve the regimen of a deep bed, if the waters were in train, which they are not, for want of a competent reach, the waters being allowed to fpread at the end of the North-wall before any train takes place; if we could therefore double the depth, we fhould halve the medium velocity, or reduce it to 20 inches per fecond, to difcharge the fame quantity of natural waters, and by the $5 t h$ Pofition, that would give us about 16 inches per fecond at bottom, which alfo appears by the 2 nd Pofition, to be more than adequate to preferve the regimen; indeed if we could treble the prefent depth at low water, we would have 9 inches per fecond, a velocity fully fufficient for the purpofe; fo that the Liffey might have more than 12 feet at low water in every part of the river, a fufficient flotage for moft of our trading veffels.

This is farther confirmed by looking at the draft of the harbour where its mouth is from 12 to 16 feet deeper at low water than in the river between the walls, but it is a principle in hydraulics, (fee pofition, 7, ) and a common obfervation, that the bed of a river may be as low, or even lower, than the bed at its entrance; the reafon is obvious, for in a river which ebbs and flows, the reflux water will drag the reft along with it by its adhefion, and confequently may fubfide many feet below the level or point of ofcillation during the ebb, in conformity to all the laws of motion.- Hence the river may be deepened above 14 feet, before it be on a level with the bed at the Light-houfe, which depth would tend to preferve its flability or confervation, and prevent its accumulating mud and filth.

It is a matter of fact that the mud, \&c. has greatly increafed between the walls these 20 years paft, efpecially on the fouth fide, and that the channel of the River has been reduced to a very fmall breadth, tho' the tides certainly rife higher than before the completion of the new South-wall; the caufe of both is plain.-The chipping lying moftly by the South fide checks the velocity of the water, occafion eddies about their keels, and confequently to depolit the filth, \&c. it carries down with it. If the veffels continued afloat, the current under their bottoms would be more rapid, but the misfortune is, that before it has fufficient velocity, the veffels take the ground and prevent the defired effect, which would not be the cafe, had they fufficient depth of water.

It might greatly promote the cleanfing and deepening the river, if the proper officers were authorifed to caufe all the veffels in the port to moor with head and fternfaits acrofs the Liffey, mid-channel, at the time of great frefhes when the celerity of the fream frequently happens to exceed 100 inches per. fecond; and confequently vaftly more than competent to fcour the river: fee Pofition, 2nd. - The fhipping being moored amid-chnnel, the current would neceflarily pafs at their heads and fterns, with additional force, by contracting the ftream, and confequently clear away all the filth bare to the fand or coarfe gravel, which might be greatly promoted by employing a Number of hands in boats to ftir up the mud with porcupines or other contrivances, by which more good might be done to the River in one winter, by a proportionate number of men, than could be effected in 50 years with 10 times the number by dredgeing alone, though dredgeing be abfolutely neceffary when the bed becomes too ftable for fuch natural means:-Befides the channel of the river would itfelf be deepened by mooring the fhips fo, by the water paffing under their keels (being afloat,) with accelerated velocity. After fuch cleanfing, the river nhould be dredged by a number of Lighters; then by a fuc-

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of fuch operations, the bed of the river might be leveled and cleared to what depth we pleafe; and I apprehend at vaftly lefs expenfe, and more fervice to the trade of Dublin, than all the fhip canals that could be projected; fchemes that would coft more in the execution, and more to preferve permanency, than all the advantages the Trade could warrant.

I muft again urge the neceffity of continuing the N . wall, to infure the fuccefs of thefe improvements, and afterwards to preferve the regimen.- The continuation might be nearly in the direction pointed out by capt. Bligh, except that the mouth fhould be confiderably wider; this would occafion the tides to rife higher, be more rapid, encreafe its cleanfing power, afford more fhelter, \&c. \&c. than at prefent; at any rate it wquld become a kind of natural canal, vaftly more advantageous to the trade of the metropolis, lefs expenfive to execute, and preferve permanent, than any canal that could be devifed.

The river flould be cleanfed, even between the Bridges, as far as the Weit end of the town, and not permitted to tumble over fords or wires, but made to pafs at the bottom, through a very long fluice or fluices of folid mafonry, calculated to the ufual difcharge of the river, the head of water to be raifed as much as poffible, but not fo high as to endanger the upper reach to be inundated by additional waters in time of freflhes, this would give fmooth water above and below the fluice, bring it fooner into train, and even augment the uniform velocity; The building of this fluice might be the work of a future day, but deepening and cleanfing the river flould be immediate.

Tho' all thefe improvements of the river are very defirable, they are only fecondary and trifing compared to the great Plan, for preferving the lives and properties of the moft valuable of the community. - There is no poffible method of effecting this, but converting the

Iftbmus of Howth into a Sound;-Of the many I have converfed with on the fubject, none could deny the practicability of doing it at a very moderate expenfe, or that the removal of the Bar, North-bull, and Baldoylebanks, would not be the immediate confequence, except one gentlemah who faid that the Bar, and Ifthmus were rockey, the firft objection is fully refuted by the experiments of Capt. Corneille, who examined the Bar by dredging, in obedience to your orders, and reported it to be compofed of a loofe running fand under the upper stratum; and as to the second, I have made myfelf as well acquainted with the fubject as I could, by frequently vifiting the place near the propofed found, and inquiring of the oldeft, and moft inteligent of the inhabitants as to the fact, who all agree in affirming the contrary, viz. that there is neither ftone, rock, or quarry, from near 200 perches to the Eaftward of Sweetman's Ale-houfe, all along the Ifthmus to the Weftward for fome miles, but a loofe running fand under the foil, for many fathoms deep; it is needlefs to ufe arguments here, where the matter may eafily be put to the teft, by deep finking or boring. - The fact is, that we would have at leaft 4 or 5 fathoms at low water, on the Bar, Bull, Sound, and Banks, were my project adopted.-I might here (like other gentlemen) difplay my nautical knowledge, by fhewing the advantages of my Plan in expediting the paffage of vefsels, bound to or from the Northward, which is by far the greater number, the moral impoffibility of any vefsels being loft while they could lie under the lee of fuch an ifland as Howth, at the very mouth of the harbour, with excellent anchorage and deep water all round, \&cc. \&c. but I confider the difquifition unnecefsary to gentlemen of your difcernment in thofe affairs.

There is probably no fituation in the world, where nature fo propitiounly invites man, to afsift in her operations as at Dublin, to convert one of the moft dangerous,

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to one of the fafeft harbours.- The Engineer who expects fuccefs and permanency of his works, muft mould his plans and fchemes to her laws: his exertions muft be made in conformity to the general train of the operations of mechanical nature. When we have any work to undertake relative to the course of rivers, we muft be careful not to thwart her general rules, otherwife we fhall fooner, or later be punifhed for the infraction; things will be brought back to their former ftate, if our operations are inconfiftent with that equilibrium which is conftantly aimed at, or fome new flate of things, which is equivalent, will foon be induced. The fpeculift may as well pretend to command the elements to obey, by the force of numbers, as the mere practitioner unacquainted with the laws of hydraulics, and the calculations of the force and equilibrium of fluids, to improve the harbour and enfure stability.- A nobleman of the firft distinction, who devoted fome of his leafure hours to mathematical ftudies, at a meeting of the Na-vigation-board, in July 1771, gave it as his decided opinion, that to enfure the fuccefs of the public works then intended to be carried on, the planning and execution of them, fhould be intrufted only to a perfon emenent for his mathematical abilities; all others, however plaufible and refined their arguments, being liable to mistakes and to impofe on themfelves, as well as on others, notwithftanding the boafted strength of their natural good fenfe.

There is a paragraph in Capt. Bligh's Report in which he fays, that a gentleman of his acquaintance, "obliged him by taking the level of the bottom under the center arch of Carlife-bridge to Dublin Light-houfe, and found it 14 feet higher than the bottom at the latter place."-I have found from repeated obfervations, made at the Marine-fchool, that the curb fone of the Quay-wall oppofite the hall-door of the nurfery, is exactly in the apparent or tangent level with the gallery of the Lighthoufe
houfe, which is 20 feet above its platform, or the top of the wall there, and deducting 9 feet for the curvature of the earth, at the diftance of the Light-houfe from the fchool, leaves 11 feet for the difference of true levels between the faid curb-fone and platform;-The platform is about 1 foot higher above 22 feet water-mark than the curb-ftone at the fchool, fo that the furface of the water at the Nurfery on the top of the tide, is about 12 feet higher than at the Light-houfe. - The bed of the channel oppofite the fchool, is 21 feet below the faid curb-ftone, (by feveral foundings I have taken) and the bed of the channel oppofite the Light-houfe is 35 feet below the faid platform, (as appears by the foundings of Capt. Bligh, allowing it feet to be the mean depth at low water on fprings, 14 feet of rife, and 4 feet from 22 feet water-mark, to the top of the platform) fo, that the difference of depths between the bottom of the river oppofite the faid curb-ftone and platform, is 14 feet, to which add 11 feet their difference of levels, gives 25 feet for the true difference of levels between the bottom of the river oppofite the Marine-fchool, and the bottom of the channel oppofite the Light-houfe, and I dare fay it is a foot more at Car-life-bridge, making in all 26 feet, inftead of 14 feet, nearly double what that gentleman affirms.-I have been the more circumftantial in my remarks here, as the cafe abfolutely required it, because any determination, afserted as the refult of obfervation, fhould be as accurate as poffible, otherwife it may lead to very fatal confequences if depended on, efpecially in thofe matters. I believe the gentleman may have been deceived, by conconfidering the furface of the water at both places (on the top of the tide) to be horizontal, and then taking the difference of the depths (viz. 14 feet) for the difference of levels, a fuppofition very erronious, even in rivers which ebb and flow if they are of any reach or extent, as I have fhewn in my 7 th Pofition.- I have ta-

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ken the following dimenfions of the Light-houfe; viz. from the platform to the gallery 20 feet; From the gallery to the lamps 22 feet;-From the lamps to the top of the dome 13 feet; and the diameter at the gallery 33 feet. - The whole height of the Light-houfe therefore above the platform is 55 feet, or above high water-mark about 60 feet.
I have been as delicate as poffible; confiftent with truth, in my remarks on the plans of others, and expect the fame treatment in their ftrictures on mine ; I have little to apprehend from the criticifms of the man of real fcience, however I may dread the carping of the illiterate.-As I am conscious of the truth of my Pofitions, the fuperior excellence of my Plan, and the juftnefs of my conclufions, all which I fubmit with the utmoft deference to your decifion.

Marine School, 13th Sept. 1803.

## I have the honour to be

Gentlemen,

To the Right. Hon. and Hon. the Direciors General of Inland Navigation.

## Gentlemen.

IHave the honor of fubmitting to the confideration of the Board, fuch addition to my plan for improving Dublin Harbour, as occured to me fince my fecond addrefs on that fubject.-I may, perhaps, in that written in 1800. and the fubfequent one written in 1803, have entered too much into mathematical and phylofophical difquifitions for the fubject.-My prefent one however, fhall neither be fo abftracted or prolix, taking facts for principles, and from thence reafon by the method of induction to the conclufioas confequent to my plan.

You will pleafe to recollect that I had fuggefted, and ? feniously recommended, the infulating Howth, and converting the prefent Ithmus into a found, as the beft external means of improving Dublin Harbour, afterwards I defrribed fuch local improvements for the river and Harbour itfelf, as I judged might be moft conducive to the profperity of the commerce of the city.-I have now only to add a Project for an entire new harbour, which I denominate Dublin Life Harbour in contradifintion to the old fatal one, as no poffibility of fhip-wrecks, could then happen either in the harbour itfelf, or at their entrance, or departure from it.-I fhall chiefly ground my prefent arguments on the very ingenious defcription of the tides
and currents about the Bay and harbour given by capt. Bligh in his Report, and alfo by Mr. Rogers in his elegant and perfpicuous views, in the fketches of the Bay annexed to his late printed obfervations on the feveral reports; both of which may be depended on as true, as they agree in general with each other, and with the information of inteligent and experienced mafters of many trading veffels with whom I have converfed on the fubject; but Mr. Rogers fketches are much fuperior to defcription, as the effect of currents can be eafily contrasted with our ideas of improvement at one view, without any painful effort or ftretch of memory, which otherwife would be neceffary. - The addition to my plan for infulating Howth, is to conftruct a new wall in a very long S-like form commencing from Ringsend watch-houfe, towards the NorthBull channel, till it arrives near the vegetable Bank or Iland on the N. Bull oppofite Baymount, (or farther if found neceffary) giving thereby a new direstion to the Liffey, but at the fame time a very gentle deviation from its prefent courfe, and therefore without the fmalleft violence to nature. This wall and the Sound of Howth would effect in a fhort time what I term Dublin Life Harbour, and which I fhall now effay to prove.

Suppofing Howth infulated and the new wall completed, the ebb-current and frefhes would foon cleanfe the channel and render it uniform, making it confiderably deeper than the prefent one to the Light Houfe, not only becaufe the direction along the propofed wall and N . Bull channel are even now very nearly as deep as the ford, patches, and fhoals of the prefent channel, but becaufe of the then greater reach, the current water would be fooner in train to caufe a deeper and more uniform channel, as I have fully proved in my fecond ad-drefs.- If it be objected, that the new channel could not be much deepened, on account of a black lime-ftone quary extending from Clontarf fhore, which fome may affert, yet the opinion of Mr . Rennie and Mr Rogers, \&c, of accomplifhing
accomplifhing a fhip canal, much nearer to the fhore than the propofed new channel of the Liffey, is a fufficient refutation; at all events, the matter might eafily be determined, by boring at different places in the line of the new channel; I am inclined however to disbelieve the truth of fuch objection, becaufe there are feveral deep guts croffing the courfe of the propofed Wall, which indicate no fuch quarry and were it even the cafe, if not of too great extent, means might be ufed to fink the Channel to a fufficient depth, much eafier than to accomplifh fuch canals, as we might by a fmall deviation in the direction of the wall, avoid the quarry, without militating the leaft againft the project or encreafing the expense.

Granting the found and new Wall accomplifhed, and the Channel along it and the N. Bull fufficiently deep (which we may reafonably fuppofe 20 feet on high water fpring-tides at leaft) let us fee what the effect of the feveral cnrrents through the new Channel and its entrance would be.——With Mr. Roger's drafts of the currents before us, we fee, that during the firt quarter flood, the current fets Northward into Sutton-creek, to fupply the channel of the N. Bull, as well as to the Northward thro' the found of Irelands-eye, while the Ebb-current of the prefent channel of the Liffey falls round the Light-houfe into the eddy, along the hollow of the S. Bult, and fo on towards Dalkey, \&c. being oppofed by the current of flood from the S. E. at the mouth of the prefent harbour rooting in underneath, and confequently forming the Bar, part of the flood current falling in with the ebb of the Liffey, and generating the South-end or tail thereof.Now it is evident, that a river ftream, muft run into the fea, for a confiderable time after the flood-tide commences, and that in proportion to the impetuofity of its current, forming a greater or lefs Bar accordingly, unlefs the ftream at its exit, falls in with the current of flood: But the current of flood entering Sutton-creek, paffing through Howh

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Howth Sound, joined by that of ebb from the new Harf bour, and uniting with the Current of Irelands-Eye found, will all three pafs uninterrupted to the Northward, and confequently, their mutual direction can generate neither Bars, Banks or,Shoals; but on contrary will difperfe thofe that may lie in the way:-Agair, when the flood-tide rifes fo high, as to change the direction of the river current, by the hydraulic principle of fluids finding their own level, which will be about the commencement of the fecond quarter (whether fooner or later is immaterial to our prefent purpofes; befides the inveftigation might be rather irkfome to thofe not much converfant in fuch refearclies) there is no oppofition to the ebb-current until the river begins to defcend on its furface, which can have very little effect, on the bottom of the Channel, and its effects more than compenfated by the fubfequent ebb, until the regimen of the channel is eftablifhed, and equilibrium takes place; fo that the fecond quarter of flood can generate neither Bank or Bar in the new Harbour.-But from half flood to high water, the current in Irelands-eye Sound fets to the Southward towards Howth head, while the Flood-tide throughout the Bay and Sutton Creek, fets to the Northward; it may be then objected, that were Howth infulated there would be oppofing currents about the Sound; but the objection is too puerile, becaufe the eddy-current in Irelands-eye Sound, is of vafly lefs force than the Body of flowing water in the Bay tending to the found of Howth, and paffing through it with vaft rapidity, the water would tend all one way, or its natural courfe to the Northward there being then no eddy water in Irelands eye found, the defect of water in fhore caufing the eddy, being fupplied through the found by the florteft paffage, and confequently no depofition of fand, but on the contrary, the removal of what may lie in the way of the current. The race thro' Howth found would not only remove the eddy current in Irelands-eye found* but alfo that round

[^1]Rofs-beg, and confequently would foon remove or at leaft greatly diminifh that Bank; thefe and much more are fully confirmed by the rules onalogy, by comparing Dalkey ifland with that of Howth.* Again, by viewing Mr. Rogers 5 and 6 plates we in hediately perceive, that from the firt to the laft of true ebb, the Currents of Dublin Life Harbour, Sound of Ireland's-eye, Sound of Howth, Sutton-Creèk, and Bay of Dublin tend all the fame way, viz. to the Southward through the middle of the Bay towards Dalkey, and confequently from the preceding principles can form neither bank, bar or fhoal.

The new harbour would be fo fituated that no forms could pofsibly effect fhipping either within the harhour itfelf, or near to it, being fheltered to the Southward and Weftward by the North-bull and new-wall, to the Northward by the line of coaft, and to the Eaftward oppofite its mouth, it is fheltered by the high mountain ifland of Howth, making fmooth water within, and confequently, vefsels riding at eafe and fafety in the midit of the greateft storms from any quarter :-Shipping with any wind, could enter or depart from it : and eafily obtain plenty of frefh water both at Howth and line of coaft ; the plan would promote numberlefs pleafure parties, there not being then the fmalleft danger at any feafon of the year, and therefore greatly contribute to the invaluable maritime fpirit of the nation; it would afford every fecurity and difpatch to his Majefty's mails to or from the harbour ; increafe the fifhing trade by diminifhing the failing diftance, and danger of fifhing-fmaks; - In fhort it would increafe the mercantile profperity and comfort of the metropolis, and confequently of the nation to an incalculable

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culable degree.-But as all thefe, and numberlefs other advantages would follow in confequence only of firt infulating Howth. Let us fee what effects from the tides, and advantages to trade, would arife by infulating Howth only, and adhering to the fituation of our prefent har-bour;-Thefe effects I have fhewn by various arguments in my firft addrefs, but not having then the advantage of Mr. Rogers drafts, or Capt. Bligb's defcription of the different currents in and about the Bay, my reafonings might not have carried fuch conviction to others, as they appeared irrefragable to myfelf; but thefe I offer now, being apparent or ocular as it were, will place my former arguments of the good effects of infulating Howth beyond a poffibility of doubt.

During the firft quarter of the flood, the current fetting into Sutton-creek would be vaftly increafed, becaufe part of it would be required to fupply the Northbull channel as at prefent, but the much greater part would pafs through Howth-found, to unite with the current through Ireland's Eye-found, all tending the fame way. One effect is obvions, that the very rapid ftream would afsist in hurrying away with it the tail of the North-bull and Baldoyle fands; but another very great effect of the firft of the flood-tide in the Bay and at the Bar, having a free paffage through Howth-found, would be the preventing of the ebb-current of the Liffey from falling into the eddy of the hollow of the Southbull, by dragging it over the Eaft bar round the tail of the North-bull, and fo on through the found to the Northward, thereby greatly destroying the caufe of the bar, and confequently, greatly promote its removal, caufing in a fhort time a deep channel to the Northward thereof, as was always the cafe until very lately, being the principle entrance to the harbour, as appears from a furvey taken in 1740 by Wm. Cutbbert and Francis Mc. Daniel, by order of 'Yames Palmer, Efq. Patentee, who had buoys placed at each end of the Bar accordingly,

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but the deterioration of the bar fince, evidently proceeds from the late improvements of the Ballaft office! To return, the whole effect of the firt-quarter of flood, would be fimilar to what I fhewed would happen from the completion of our Life Harbour, to which I refer; And during the laft three-quarter-flood, its effects on the bar and harbour would exactly be the fame, as I defcribed it would be in the new harbour, from fecondquarter to high water, which you will pleafe alfo to recur to.- But here I mut remark, that the flood would pafs in a more direct manner over tle Bar to the harbour than at prefent, on account of a much greater body of water, then tending towards the Sound of Howth; -I beg likewife to refer your honours to my reafonings on the effects of the whole of the ebb-tide in the new harbour being equally applicable here, with this remark, that during the laft quarter-ebb, when its current has the greatest effect to remove fand (and confequently to form banks and bars if oppofed by a contrary current) will pafs directly over the bar, and not fall round the Light-houfe into the hollow of the Southbull as at prefent, being then drawn by the great body of water paffing through Howth-found, \&c. making directly through the center of the Bay for Dalkey.The ebb-current of the Liffey by thus pafsing more directly over the bar will deepen it, as well as the very rapid current thro' Howth-found will fcour all before it. The amazing fcouring property of fo rapid a current: as in Howth-found, which would be at leaft 4 or 5 knots, may eafily be conceived or if more agreeable, the computation may be feen in my firf addrefs in 1800 ; but in all thefe defigns Nature fhould be afsifted to expedite her operations, by means of iron berrorés, porcupines, \&c. as I firft fuggefted in that addrefs; - In fhort by only infulating Howth, and the endeavours of nature afsisted by art, we obtain almof every advantage I have enumerated would arife from completing the Life Har-
bour, indeed all we could modefly defire.-But as the bassis of the new harbour, or the real improvement of the prefent one, is the infulating of Howth, every idea of improvement but this fundamental one, fhould be fufpended until that be fully accomplifhed, after which fome of the detached improvements about Howth, and Ireland's Eye, as alfo at Dalkey, might with great propriety be executed, fome of them promifing very extenlive advantage. - And tho' I may not be endowed with the irreffitable (tho' not always convincing) powers of perfuafion, yet as I know that facts are ftubborn, and fcientific reafons incontrovertable, I am bold to challenge any Engineer in the kingdom at the peril of his character, publickly, to offer even one rational objection to my plan for improving Dublin harbour, by infulating Howth, either as to the impracticability, incommefurate expence in the execution, any injury to the prefent harbour, 'till completed, or even any deficiency in the great benefits I have fo frequently exprefsed to be expected thereby.

I fhall now mention a few of the evil confequences that will arife from completing the propoled plan of the Ballaft office, or the farther extenfion of it as recommended by Mr. Rennie, but as I cannot avail myfelf of the prerogative of fome gentlemen of making general. ilssertion, and assuming affirmation for proof, I muft necefsarily appeal to reafon, and the laws of nature; Firfly the South-bull, in a fhort time, will be hollowed much more than it is at prefent, nearly to its prefent center, by the S. E. winds, eddy-currents, and encreafed ebb-current of the Liffey, from the third-quarter of true ebb, to the fecond-quarter of flood, that is, while it has the greateft power to produce the effect; alfo it will in thie fame time extend the bar as far as the Southbull channel, (for the fame reafon that the bar is formed) curving it inward, to nearly the faid center, the bar aillo approaching nearer to the Light-houfe, and fo in-

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creafed, that no vefsel of burden can direetly approach the harbour, thefe evils will certainly take place on completing the propofed improvements of the Ballast office, which is the fubject of your honors late reprefentation to the Lord Lieutenant. Other injuries attendant on the execution of their plan, I have reprefented in my fecond addrefs; even $M r$. Rennie's extenfion of their project will only the fooner expedite thefe evils, encrealing the hollow of the South-bull, and eddy, incurvating and extending the new bar, much more than the old one, and rendering the pilotage and navigation vaftly more difficult than at prefent; caufe more fhip-wrecks, and the lofs of more lives and property than has ever yet been experienced; the rampart wall if completed, will never prevent a fingle fhip-wreck in the Bay or its vicinity; it can only afford additional fhelter within the prefent Harbour, a defect little complained of, and the advantage expected infignificant, compared with the expense of accomplifhing the defign; and the greater injury it will occafion by generating a fecond and infurmountable bar within the Harbour itfelf, as may appear from my fecond addrefs; and fhould it be adopted in preference to what I have fuggefted, I have only to remark, that future generations will have for ever to lament the decifion.—Your honours having obliged me with fome of Capt. Bligh's reduced maps of the Bay, \&c. enables me to accompany this paper with a fketch of my plan for the improvement of the prefent Harbour, as alfo the project of what I denominate Dublin Life Harbour ; indifpofition prevented me from fubmitting it and the preceding reflections to your confideration fooner.

> Marine School, \} I bave the bonour to be, 18th Nov. 1805. $\}$

> Gentlemen,

> Tour very dutiful Servant,

WM. M : MINAMY.

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> To the Right Hon. and Hon. the Directors General of Inland Navigation of Ireland.

Gentlemen.

THAT I am fomewhat anxious about the reception which your honors are pleafed to beftow on my projects for the improvement of Dublin Harbour, it were diffimulation to deny, but to be ambitious of obtaining your approbation of them, is an honest ambition, which fhould not be restrained when it tends to benefit our commerce, and to the prefervation of our mariners:Thefe motives impel me once more to lay before your honors, fuch addition to my general plan for that purpofe as occured to me fince I had the honor of laft addreffing you ;-It is now feven years fince I firft had that honor, during which period I have frequently, with the utmoft attention, confidered the various plans propofed by other gentlemen, and alfo re-confidered my own as impartially as I pofsibly could, without being able in the leaft to reconcile any of theirs to the nature of things, or to make any reafonable objection to my own, as to the arguments on this head, I beg leave to refer you to my preceding papers;-It will be recollected that 1 always endeavoured to adapt my plans to the operations of nature, and the fituation of our port ; her laws I took for my principles and guide, as the fureft means of fucceifs

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fuccefs in fuch undertaking, becaufe they are foimperious that any infraction of them, will furely render the refractory fchemes abortive in time, by either overturning thofe fchemes altogether, or inducing fuch a new ftate of things as to make them entirely ufelefs : or otherwife to accelerate and increafe the evil they were intended to remove. -In my firft letter I recommended the infulating Howth as the best external means of improving the harbour; In my fecond I propofed means of deepening and cleanfing the river itfelf. And thirdly, I defigned a project for an entire new harbour, which I denominated Dublin Life Harbour, in contradistinction to the old fatal one: -And now I would recommend another new entrance to the prefent harbour, by which we would obtain a fafe and commodious outer one, with deep water, well fheltered from S. E. ftorms; of eafy accefs, and fhorter paffage than at prefent, without any bar, or other obftruction to the entrance, and affording the greateft fecurity and relief to vefsels deeply imbayed in hard gales blowing infhore, when they neither could ware or flay to work it out, turn the Light-houfe, or ride the gale out in the Bay.-But the better to underfand the reafon of the necefsity and advantage of fuch an entrance as here propofed, we muft be well acquainted with the fetting of the tides and currents in and about the har-bour.-During the firf three-quarters-ebb, the united current of the Liffey, Dodder and Ballybough rivers glides along the South-wall, part of it fetting due-eaft over the bar towards the Bailie, 'till it falls in with the true-ebb fetting South paft the nofe of Howth, while the other part unites at the bar with the eddy current that comes north from Dalkey-found along the coaft, falling into the hollow of the South-bull and winding back again from the Light-houfe to the fouthward over the center of the bay 'till it falls in with the true ebbcurrent in the offing oppofite Dalkey;-During the laft quarter-ebb, and the firf quarter-flood, the currents fet Weftward

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Weftward from the Bailie, and Southward of Rof beg towards the bar, where they are met and oppofed by the current from the harbour fetting Eaftward, and after their collifion at the bar they all conjoin and fall into the hollow of the South-bull and along the coaft, through Dalkey-found, \&c.-During the fecond quarter flood the ftream fets in for the harbour over the center of the Bay, but divides at the bar, a branch of it falling into the eddy in the hollow of the South-bull, and along the coaaft towards Dalkey, \&c. while another branch fets Eaftward towards the Bailie and round Howth into Ireland's Eye-found ;-From half-flood to high-water the tide fets alfo over the center of the bay for the harbour, but there is no eddy in the hollow of the South-bull, as the tide comes from Dalkey along the coaft and round the Light-houfe into the harbour, while the eaft branch feperating from the main body at the bar, makes for the Bailie, and forms an eddy to the Southward round Rofs-beg;-There are therefore above three hours oppofing currents at the bar, and that while they have the greateft power in generating that bank, viz. during the laft quarter-ebb and the firft quarter-flood; there are befides above four hours and a half continuence of the feperation of the tide waters at the bar, making flack water there, and confequently tending to its accumulation by affording time to the floating fand to fubfide, and that while the waters are moft replete with it, viz. from first quarter-flood to high-water, making in all above feven hours and a half's continuence of contrary currents at the bar, or above fifteen hours in every twenty-four. The bar cannot accumulate higher than the place of the equilibrium of the under waters, which height it will always preferve until an alteration be induced in the place of that equilibrium, by fome change in the generating caufe either by art or nature.
We may affume alfo as a fact fufficiently eftablifhed by many affidavits, and numerous reports, and charts, that
formerly there was a deep and wide channel to the Northward of the bar, which was the principal entrance to the harbour ; the bar was then but of a fmall extent, in form of an oval ifland, having alfo a fouth entrance as at prefent, there was alfo a channel called the South pafsage from Cock-lake in Salmon-pool, a little to the Eaftward of the place where the Pidgeon-houfe now ftands, through which many fhips chofe to pafs, being far more fecure and fafe, and a much fhorter paffage, to or from the Southward:-But the Directors of the Ballaft office (eftablifhed in 1707) obferving that the current from the City fet directly Eaft over the bar during the firft three quarters of the ebb tide, very naturally conceived that if a work of piles or ftone was conffructed in that direction, it would preferve a ftability and uniformity of channel, which was before fubject to great mutation every winter from South Eafterly forms, befides the fhelter it would afford flippiag in the harbour from the effect of thofe winds. -This very laudable defign has been accomplifhed at an expense of upwards of $£, 0200,000$, But alas! tho' we have gained a more permanent and uniform channel in the harbour than heretofore, and fhipping lying in the harbour afforded fome additiona! protection from fouth eafterly winds, yet melancholy to relate, that more flip-wrecks have lately happened in paffing the bar, and the lofs of more lives and property in a given time fince the completion of the South-wall than eyer had been before it. The eaft channel or entrance to the harbour has been entirely filled up, the bar rapidly increafing and extending in an incurvated manner acrofs the mouth of the harbour, which will foon be fhut up, by the fouth end of the bar ftretching fo far to the South-weftward as to make the navigation vaftly more difficult, precarious and dangerous, than even at prefent;-The South-bull hollowed out much more than it formerly was, which is now very fteep clofe to its edge, as appears by foundings lately taken by order of
the Ballaft office Directors, whofe officers report that there are 11 feet at low-water fpring-tides clofe in with the Bull, whofe edge has removed greatly to the Weftward, the fand being thrown up, which generates the white bank:-All thefe growing evils are occafioned by completing the South-wall, before that, the laft two hours of the ebb, and the firft two hours of the flood nearly, the eaft current of the Liffey had a free paffage fo the Southward through the South-bull gut at Cocklake in Salmon-pool, and alfo through other fmaller guts in a fouthern direction to which it naturally tends at thofe times, and thus the Weft current at the Bar, and the Eaft current of the Liffey by that avoidance, did not clafh or counteract each others effects, to generate thofe evils which they do at prefent, by the Eaft current of the Liffey on the laft quarter-ebb and the firft quarter flood, being now obliged to run as far as the Light-houfe, before it can fet to the Southward in its natural courfe at thofe times; and in getting round the Light-houfe, it is prefled into the hollow of the South-bull by the Weft current from the Bailie, which occafions the South-bnll to be greatly hollowed, efpecially near the wall at the Lighthoufe, and the edge of the bank which was formerly thelving, is now very fleep, the fand being thrown up by the ioint action of thefe currents after their collifion, affisted by easterly winds, and collected againtt the back of the wall which protects it, and forms the white bank. -Thefe facts being premifed, let us but " remove the caufe and the effect will ceare,"-All the evil effects of compleating the South-wall will be removed, while all the advantages it affords will be retained, by only making a fufficient breach in the wall clofe to the Pidgeonhoufe between it and the white bank, to permit the Eaft current of the Liffey, \&c. to pafs freely in its natural courfe to the Southward into the South-bull channel during the laft two hours ebb, and the firft two hours flood at the bar;-The plan is only to open the old paffage
paffage through Cock-lake in Salmom-pool, which will foon, by the rapid current through it, become navigable for the largeft veffels trading to Dublin :-No fand, in confequence of the breach, will ever be driven through it into the prefent harbour, as the firft half-tide of flood, and the firft three-quarters-ebb, has always and ever will come in and go out in the direction of the South-wall but from half-flood to high-water the tide will make alfo for the harbour through the $n \in w$ channel, the water being then of fufficient depth, can have little power of removing fand; and what effect it has in difturbing the fand, or what fand may fubfide during flack-water, on the top of the tide, is more than compenfated by the much greater ftrength of the contrary current for an equal length of time, viz. for the laft quarter-ebb, and the firft quarter-flood, when its power to remove fand is the greateft poffible.-But it may be found neceffary hereafter to conftruct a work of piles or ftone on the eaft fide of the new channel, along the South-bull gut and the Weft fide of the White-bank, to protect fhipping from the violence of Eafterly winds, and to preferve a greater uniformity of channel thro' the new paffage :By thus adopting our plan to the endeavours of $\mathrm{Na}-$ ture, we Ghall have an excellent outer harbour to the Southward of the new wall, of eafy accefs in the greateft Eafterly winds, well fheltered by the White-bank and Eaft piles or rampart wall, with fmooth water and of fufficient depth within, free of any bank or bar at its entrance. - The fea is never very turbulent in any part of the South-bull gut, its violence being broken off by the White-bank, and will be much more broke off when the new work is conftructed;-Many people affirm, that the gut from the tail of the White-bank to its moutl. is already as deep or deeper than any part of Poolbeg:There never was, nor ever will be any bar or bank at its entrance to prevent a free paffage through it, becaufe no contrary currents at the fame time can ever

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lappen there; -I fay that this beach will remove in a flort time all the evils complained of fince the completion of the South-wall, without the fmalleft injury to any of the advantages it has produced; befides it will occafion a fafe and commodious outer harbour, of eafier accefs and florter paffage to the Southward than the prefent; prevent flipwrecks about the Bay, as veffels may with eafe and fafety run in for the new harbour, where they will be well fheltered from thofe dangerous winds which have proved fo fatal heretofore.- I have often been asked by very intelligent men as to fome method of remedying the evil effects of the South-wall, without injury to the great advantages it affords, and $\overline{1}$ have as often anfwered that a fufficient breach betweenthe Pidgeon-houfe and White-bank would have the defired effect, at the fame time giving my reafons, which was never objected to except in the fituation of the breach, which fome gentlemen thought fhould be made 1ome where between the Light-houle and White-bank, as for inftance about the elbow of the wall, or about the five-gun-battery, in more immediate deep water on both fides of the wall; but in my opinion it would afford nly a temporary remedy without ftriking at the root of the evil, occafion a great joggle at the Pier-heads and a turbulent fea without any fleher in Poolbeg in the beft of the water, to the great hazard of fhipping and injury to the trade of the metropolis, efpecially in fouth eafterly ftorms, which have proved already but too fatal toithe lives of our mariners ;-all which evils not only are avoided, and thofe alfeady complained of removed, but many and great advantages would be obtained, by making only a fimple breach between the Pidgeon-houfe and White-bank as herein propofed; the effect of the current to deepen the paffage to and along the Southbull gut may be accelerated by means of dredging, porcypines, harrows, \&c. as formerly recommended for Erepening the found of Howth, \&\&c.

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The effect of a breach where I have propofed is at leaft worthy of an experiment, efpecially as it may be made at a very trifling expenfe, and can induce neither inconvenience or injury to the prefent harbour ; and the communication of the South wall may eafily be preferved by draw-bridges as recommended at Howth found.-The plan does not in the fmalleft degree clafh with the advantages obtained by the great work lately completed by the Corporation for improving the harbour, but is only a farther extension of that improvement; we have not therefore to encounter the delicacy of undoing what they have already done, nor they the neceflity of acknowleging any defect in their original defign. But here I beg to remark that this and every other plan for the improvement of Dublin Harbour, are only fecondary to the vaft improvement and advantages that would be obtained by the infulating of Howth, as recommended in my firft addrefs in the year 1800.

If honored with your commands, my ideas of this plan fhall alfo be sketched out on the reduced maps of the Bay, on which I have traced my former defigns, and which will give a connected view of all my propofed improvements of the Port and Harbour of Dublin.

Marine School, 15th Sept. 1807.

IIM. Gentlemen,
rour mof dutiful Servant,
WM. M• MENAMY.



(1)


[^0]:    *Improperly called an indraugbt, becaufe the waters are impelled, and not drawn towards the fhore.

[^1]:    * Belices fhould the eddy current in Irelands- Eye found, not be changed by the race in Howth found, yet they weuld wot clafl or oecafion any bar, but on the contrary would only confpire to fend up a much greater tide in the new Harbour to the City, to the great benefit of Commerce.

[^2]:    - Note here, for fear I might be mifunderfood. I mean not to fay that the direction of the currents about each Illand at the fame time is the fame way, but that the currents about each Ifland refpertfully would be the fame at the fame time, and confeguently no Banks or Ears about Howth any more than about Dalkey.

