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THE CRY

FOR

NATIONAL HARBOURS,

AND

ITS CONNECTION WITH OUR DEFECTIVE SYSTEM

OF

PUBLIC HARBOUR LEGISLATION.

BY

CAPTAIN E. K. CALVER, R.N.,

F.R.S., A.I.C.E.

LONDON:

P. S. KING, PARLIAMENTARY BOOKSELLER,

KING STREET, WESTMINSTER.

1876.

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THE CRY

FOR

NATIONAL HARBOURS.

—o—

OUR FAILURES.

HARBOURS are of the utmost importance to an insulated country like ours, and they are divisible into two classes —the one is intended to promote local interests, by providing means for commercial intercourse; the other is for the more general object of supplying refuge from storms, or for serving the purposes of war. It is to this latter description of harbour that the following remarks are exclusively directed.

Within the past thirty years, or thereabouts, we have formed several of these public ports at a great outlay, and with a result, it must be added, no less wasteful of the national funds, than it is derogatory to our character as a practical people. The cause of this failure has for long been apparent to the writer, and he has often, during his employment of thirty-six years in the Surveying Service of the Navy, and while officially engaged in such matters, pointed it out and suggested a remedy, so far as his position permitted it to be done. Recent circumstances, however, connected with the renewal

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and promotion of a costly and defective scheme for another public harbour at Dovėr, have conclusively proved that nothing less than an unflinching, but temperate, exposure of our system of public harbour legislation (the cause of the evil) will be of any avail in helping to arrest this continued waste of the national resources, and to this task the writer briefly addresses himself.

Some striking examples of the practical results of the system will be given, most of the details of which, being contained in printed public documents, may be verified at any moment. Doubtless, many of the readers of this pamphlet have but slightly studied the subject of which it treats, or, it may be, not at all: the conclusions arrived at will therefore be supported by such facts and illustrations only as may address themselves to the understanding of every intelligent person.

While the subject of discussion is connected with nearly the whole official life and the experience of the writer, it is also intimately interwoven with the interests of the tax-payers, who well know that free enquiry is the best remedy for any evil, and that all useful reform is, more or less, the result of it. No one can object to, or be harmed by the right herein exercised of making use of the acts of public men for the furtherance of the public weal; but the subject is undoubtedly a delicate one, and while impugning a pernicious system, and placing the facts connected with it in bold relief, that they may be clearly seen and understood, it will be the object of the writer to try to avoid giving offence to those persons who, from circumstances connected either with position or with custom, are employed as the agents for carrying it out.

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The subject naturally embraces three points :—our failures in harbour projection and construction; the cause; and the remedy.

Alderney.—The first example is a marked one—it is that of the Government works at Braye Bay, in Alderney; and as their history is instructive, and more or less typical of what has taken place elsewhere, it will be given at some length.

From an account contained in a letter, or report, addressed by the late James Walker, C.E., on the 26th May, 1850, to the Secretary of the Admiralty, it appears that in 1842, at a time, it will be remembered, when the idea of a French invasion was very prevalent, and there was a tendency to resort to panic-legislation, the late General Sir William Napier, the Governor of Guernsey, addressed a communication to Sir Edward Codrington, the Commander-in-Chief at Portsmouth, upon the defence of the Channel Islands, which were within the Admiral's district. This, in turn, was forwarded to the Government, and General Cardew, Captain Sir Edward Belcher, and Colonel Colquhoun, officers of the Royal Engineers, Navy, and Artillery respectively, were ordered by their several Boards to examine the defences of the Channel Islands, in their bearing upon the security of commerce, &c. In their subsequent joint report, they recommended as sites for harbours, St. Catherine's Bay and Anne Port in Jersey; Longy Bay in Alderney, and the bay to the south-east of St. Peter's Port in Guernsey. In July 1844, Mr. Walker was directed by the Admiralty to submit his opinion as to the practicability and cost of the proposed harbours: he objected to Anne Port, and to some other bays in Jersey that had been

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selected for breakwaters; also to Longy Bay in Alderney, as well as to the bay north of Terres Point in Guernsey; but he agreed with the Commissioners in their selection of St. Catherine's Bay, and recommended besides the formation of harbours in Braye Bay in Alderney, and in the bay to the southward of Terres Point in Guernsey.

In September 1845, Mr. Walker was instructed by the Admiralty to purchase land for the uses of the proposed harbour in St. Catherine's Bay, Jersey, and the Treasury, at the same time, acquired the property needed for public purposes near to the same site, and to Braye Bay in Alderney. During 1846, Mr. Walker several times pointed out to the Admiralty that, in his opinion, Braye Bay was the best situation for a harbour in Alderney; that one could be formed there in every way superior to that proposed at Longy Bay, in the same island, and, to further justify his preference, he mentions that Braye Bay might be as readily defended as Longy Bay, and that the former site had the approval of Sir William Napier and of Captain Martin White, R.N. As a result, the Admiralty announced to Mr. Walker, on the 14th of November of the same year, their resolution to proceed at once with the Alderney harbour he had recommended.

Mr. Walker originally designed at Braye Bay a harbour of 67 acres only, and his estimate for it was £300,000; then additional height and length were given to the breakwater, and the estimate increased to £400,000. This again had swollen to £620,000 in 1850; in 1854 (for an extended scheme) to £880,000; and in 1855 (embracing another extension) to £1,300,000—about the sum the harbour appears to have cost. This work, begun in

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January 1847, practically completed in 1864, and employing no less than 4,360,000 tons of stone in its formation, consists of a breakwater 1609 yards in length, with two straight lengths of 1000 yards next the shore, and 436 yards towards the head, joined by a curve (concave to the sea) of 500 yards' radius, and 173 yards in length, the angle between the two main portions of the breakwater being about 160°. The mound, or base of the work, is 52 yards wide at the top, and has natural slopes to the bottom; the parapetted superstructure reaches to the height of 21 feet above high-water mark, and the head (or outer end) of the work is in the extraordinary depth of 130 feet below the level of low-water spring-tides.

Owing to the breakwater being exposed to the destructive power of an Atlantic sea, aided by a rapid current, and that the great depth it stands in admits of the deep-water undulation bursting upon it in an unreduced form, it will be readily understood that considerable difficulty was experienced in forming the work. Several times while in progress, it was injured by storms, and it sustained serious damage after completion, particularly in the winters of 1864, 1866, and 1868. In January 1870 it was completely breached through in two places, and in consequence of this misfortune, Mr. Lefevre, the Parliamentary Secretary of the Board of Trade, and Captain Evans, R.N., C.B., F.R.S., (the present Hydrographer of the Navy), were directed to visit Alderney, and inspect the damage thus sustained. The Report made by Captain Evans is exceedingly instructive as to the real character of Alderney Harbour. He says, in substance, "that Nature has done nothing for it, for all the conditions favourable to a port, so constructed,

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are wanting—the shores are rocky and jagged—the water in which the breakwater is built is deeper than in any similar work in the world—the tides in the immediate neighbourhood run with unusual velocity, whilst its position is exposed to very heavy seas, and to the stormiest winds of the Atlantic Ocean." He adds, that, "in the strict sense of a harbour of refuge, Alderney must be considered as wanting nearly all the essentials—the bottom enclosed by the breakwater is rocky, with only a few scattered spots of good anchoring-ground—that though two sets of moorings for line-of-battle ships and two for frigates are laid down, ships of that size could not swing clear of each other, and an erroneous idea was conveyed by the term 'moorings.'" Captain Evans also appeared to recognise the necessity for leaving the outer portion of the breakwater to its fate.

A few months after the foregoing examination, Mr. Hawkshaw, C.E., (now Sir John Hawkshaw), and Lieutenant-Colonel Andrew Clarke, R.E., C.B., (now Sir Andrew Clarke), Director of Works, reported to the Board of Trade upon the same subject. Assuming the abandonment of the outer part of the breakwater, they submitted two plans with corresponding estimates of £142,000 and £197,000 for rendering the inner length secure, pointing out also, as an alternative measure, that it would take about £10,000 to repair the recent breaches, and a similar sum annually to maintain the whole work till some decision had been come to respecting it.

In 1871, when upwards of £44,000 had been paid for damage alone (in addition to that borne by the contractor), and when the real character of Alderney Harbour was forcing itself upon

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public attention, the proposed vote for its maintenance, scarcely supported by Government, was struck out of the estimates in the House of Commons without a division: as a consequence, the contract was wound up, the plant removed, and the breakwater left to its fate.

In 1872, the subject of the harbour and fortifications of Alderney was fully considered by a Committee of the House of Lords, and the evidence of various military and naval officers was taken. The military witnesses stated that the primary object of the expenditure at Alderney was to afford an anchorage to a certain number of men-of-war which might watch Cherbourg with facility—that some of the fortifications erected for the defence of the harbour at an expense of £262,000 would have to be given up, and others modified to render them equal to the present conditions of warfare, and that it would take 1500 men to garrison them. The naval evidence was to the effect that the place was useless for refuge—that owing to foul ground and want of space, it could only stow one large iron-clad, a couple of smaller ones, and a few light craft, and that the outer arm of the breakwater, which had been breached so frequently, was a mistake—still, as the harbour might possibly be of some use in guarding the south side of the Channel, the inner and less exposed arm of the work had better be maintained; but they were nearly unanimously of opinion that the harbour was of no value for keeping Cherbourg in check—the sole object for which it was built. The military and naval witnesses both agreed that the harbour and the works for its defence must now be maintained and occupied, to prevent their falling into the hands of an enemy. The Report of the Committee was in

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accordance with the foregoing evidence, and as it was shown that it would cost more to destroy the works than to keep them up, they recommended the temporary maintenance of the breakwater, and the obtaining further information, to admit of some policy being adopted with regard to the whole subject.

An extract or two, from the memoranda of the Director of Works, submitted with the Navy estimates of 1875-76, will bring the history of this unfortunate project down to the present day. Colonel Pasley states that "subsequently to the Report of the Lords' Committee in 1872, repairs, which appeared the most urgent, have been made from time to time, but that in November and December of 1874, a succession of heavy westerly gales bringing a terrible sea against the breakwater, a much larger breach than either of those which had been repaired in the previous summer was formed at a distance of about 200 feet from the end. The portion thus carried away included a part of the work recently renewed." Additional disaster quickly followed, for he goes on to say that, "at the latter part of January succeeding, the breach formed in December has increased to a length of about 150 feet, and another great breach has been formed at a distance of about 400 feet from the end of the breakwater. This would probably increase the cost of repairing the outer arm to £25,000 or £30,000, with the prospect of a similar expenditure being subsequently needed at uncertain intervals." This, certainly, is a striking commentary upon the hope expressed by Sir Andrew Clarke (one of the Reporters for the present Dover Harbour) before the Lords' Committee two years previously, that "we have seen the worst of the damages at Alderney, and that £5000 or £6000 a year (on the average) would maintain it"!

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Colonel Pasley advised that the outer part of the work be left to the unchecked action of the sea until it had been reduced to the condition of a rubble-bank, or artificial shoal, and that when the superstructure had been swept away to the inner part of the curve, the remainder of the parapetted work should be terminated by a head, at an expense of about £20,000 or £30,000.

Such is the history of the works at Alderney, and a humbling one it is. No wonder that the Lords' Committee of 1872 entertained the idea of "blowing up the breakwater, dispersing the foundations, and filling up the harbour," as the proper solution of the question. But this remedy is denied us, and, like Sinbad with the old man of the mountain upon his shoulders, we are permanently burdened with the maintenance of Alderney Harbour and fortifications: not that they are of any use to us, but only to prevent their falling into the hands of a hostile power! It is difficult to conceive a case of more complete retribution for a practical mistake.

St. Catherine's Harbour, Jersey, affords the second illustration of the working of the system—a project which had the same origin as that at Alderney. The first estimate for it was £700,000, and comprised two breakwaters; one 800 yards long from Verclut Point, the other 1800 yards long from near the Archirondel Tower, the space between them being about 250 acres. The work was begun in June 1847, but in 1849, when a material advance had been made with the Archirondel breakwater, it was abandoned as useless, and a detached work, in an altogether different position, adopted in its stead.

Were it not explainable by the system in vogue, it would be

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difficult to conceive why a harbour intended for refuge and war could have been projected at St. Catherine's, for, both geographically and physically, the site has no value. In south-westerly and westerly gales, the heaviest in the Channel, the island itself affords cover, and the harbour is not wanted; neither is refuge needed in easterly gales, as the French coast is only twelve or thirteen miles off in that direction. The space, also, between the breakwaters is nothing less than one mass of foul ground, for five pinnacled masses of rock, "Le Graveur," "L'Auberge," "Small Bas," "Large Bas," and "Élat," with only four to seven feet over them at low water, encumber the deeper portion of the harbour. It is evident, therefore, that to render the space fit for berthage, it would be necessary to remove these masses with their prongs by blasting, or other submarine means, at an enormous expense; consequently, the original estimate of £700,000 was utterly misleading.

Captain Bushnel, R.N., who commanded a steam-vessel for several years in this neighbourhood, and knew it well, told the Lords' Committee respecting the Verclut work that there was "a tremendous tide-way off the head of the breakwater," and he added, "I have known the ship I was in turn completely round when I was going full speed"—a feature which would have existed in an aggravated form across the completed entrance. Need we wonder that the works at St. Catherine's, consisting of the Verclut breakwater, and the shore end of that from Archirondel, which, irrespective of land, had cost upwards of £234,000, were finally abandoned as useless? But there they remain, so long as the waves spare them, as monuments but ill calculated to foster our insular pride.

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Holyhead Harbour, in Wales, is the third example. Designed by the late Mr. Rendel, C.E., as preferable to that advocated by Mr. Walker and Admiral Beechey, it was primarily intended for the shelter of ships driven back on their course by south-westerly gales in the Irish Channel—a purpose for which it is well fitted, owing to the advanced geographical position of its site. The northern and eastern breakwaters of Mr. Rendel's harbour, exclusive of land, were estimated to cost £628,066; £477,002 being for the northern work, and £151,061 for the eastern one: an additional sum of £150,000 was set down for a packet pier.

The northern breakwater (the only one hitherto constructed) was superintended by Mr. Rendel during his lifetime; it was then considered rather novel in character, and consists of a basement of "*pierre perdue*" (or loose rubble) up to low-water mark, surmounted by an upright wall carried up well above the level of high-water springs, with an esplanade, or quay, within it. This style of breakwater, so far as the writer's information extends, appears to have answered at Holyhead, as well as at Portland, where it has also been adopted; but in 1858, when passing circumstances brought the subject of breakwater construction prominently before my attention, I remarked, on page 28 of the "Wave Screen" pamphlet, written at the time, that "this mode of forming breakwaters has yet to be tested. But, remembering what forces it will have to encounter, the writer is of opinion that it will be found defective; experience will probably prove, that while it has the breaker-forming property of the long-slope breakwater, it lacks the power of resistance of the upright wall" —an opinion which was amply vindicated afterwards in the history of similar works adopted at Wick, and at the mouth of the river Tyne.

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To revert again to Holyhead. About the year 1855, the authorities became aware that the harbour of refuge they supposed they were forming there was no harbour of refuge at all, as none but small and handily-worked vessels could get under its cover when refuge was most needed; accordingly, an entire departure from the original plan was sanctioned, and a prolongation of the breakwater in a new direction designed and carried out to shelter what may be termed the outer roadstead. It will be remembered that a similar radical change took place in the works at Alderney; and it is no defence of such fugitive and ill-digested measures to say, they were owing to the authorities having more comprehensive views at one time than at another, and still less, that the cause is to be found in the increased depth and space required for vessels of increased size.

The breakwater passed into Sir John Hawkshaw's hands after Mr. Rendel's death, and he advanced it to its completion in 1869. The works at Holyhead, as we know, were originally sanctioned by Parliament, upon the understanding that a refuge-harbour, formed by two breakwaters, could be constructed for the sum of £628,063, and the Admiralty entirely depended upon the guarantee of a minute estimate of Mr. Rendel's to the same effect. Instead of this, one breakwater, partly covering an outer roadstead only, has cost £1,400,000, or more than double the original estimate for two breakwaters and a complete harbour! Not only so; a minimum of accommodation has been provided by a maximum outlay; for it is humbling to observe, upon a study of the site, that a breakwater of a different flexure and 900 feet shorter than the existing one, would have covered in sixty-eight acres of additional deep-water space, and at the same

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time have rendered the harbour far more accessible for purposes of refuge.

It will thus be seen, that although the harbour at Holyhead is, by no means, so gross a failure as those at Alderney and Jersey, it nevertheless supplies several lessons well calculated to be of use for future guidance.

Dover Harbour, the last example to be brought forward, is of present importance, owing to its being just now before the public; and it is highly desirable that it should not be added to the list of mistakes we have been considering. In describing the case in detail, free use will be made of the information contained in the "Wave Screen" pamphlet of 1858, already mentioned, and in another entitled "Remarks on the proposed National Harbour at Dover," circulated in March of last year, in anticipation of the meeting of the House of Commons' Committee to consider the Bill.*

Dover is the most advanced south-eastern port and fortress of Great Britain, and has always been considered of such naval and military value, that an area of about thirty acres is now covered by ancient defensive works and modern fortifications. In 1844, when we were passing through the undignified process of a groundless alarm, a Royal Commission recommended a harbour to be formed at Dover of not less than 520 acres of area outside low-water mark, and various leading engineers of the day, as Vignoles, Cubitt, Rendel, and Lieutenant-Colonel Harry

* The latter of the two, containing various information respecting Dover which cannot be repeated here, may be obtained from the publisher, Mr. King, of King Street, Westminster.

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Jones, acting under instructions from the Admiralty, designed more extensive enclosures, the heels of the eastern breakwaters of their several harbours being abreast the Cornhill Telegraph, about half-way between Dover Castle and the South Foreland. The writer surveyed for the Commissioners the frontage of Dover, and several of the other selected sites, and he also gave evidence before them; but at that time he had only three years' knowledge of the points the Commissioners were dealing with. Now, after ten times the experience, it is at once admitted that a portion of this evidence is not sustainable, particularly that which had reference to silting, and the writer drew attention to its immature character in the pamphlet of 1858—a point to be referred to again shortly. Indeed, no one of experience can now peruse the record of the proceedings before the Commissioners without being forcibly struck by the crude character of the views then entertained by engineering and other witnesses as to the nature of waves and their effects, the laws which regulate the suspension and deposition of floatable matter, and the character of the structures best adapted to meet exposure, and consequent sea-stress. The Commissioners, however, recommended, as has been said, a large harbour to be built at Dover, of which the present Admiralty Pier, begun in 1848, and carried out at a cost of about £1000 a lineal yard, is a portion of the western arm. This noble work, which is well worth its cost, is a wall of granite and concrete with nearly perpendicular sides, furnished with every necessary accommodation for the berthing of steamers and the landing and departure of passengers; it has been constructed under the sole supervision of Mr. Edward Druce, C.E., and will always be an enduring witness of his superintending care, and

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his ability as a constructor. In 1865, when the principle of close-harbour formation was better understood, and more especially the risk of silting (or choking) to which such a harbour would be exposed, a committee (of which the writer was a member) was sent down to Dover to decide the extent to which the Admiralty Pier should be carried out, and it has since been completed as then recommended. The Royal Commission of 1844, having laid stress upon refuge as one of the principal advantages of a harbour at Dover, we remarked in our Report, "that with the anchorage of the Downs so near at hand, the consideration of a harbour of refuge from storms may fairly be dismissed;" and with regard to a partial adoption of the scheme of 1844, and the drawbacks attached to it, we further observed, that "this very important question can only fairly be decided after deliberately weighing the possibility of a national necessity for further accommodation against the expense of maintaining the advantages to be expected from it." So the matter rested till March 1874, when an announcement appearing in the *Times* that it was the intention of the Government to carry out a large national harbour at Dover, I wrote a letter to the editor (which duly appeared in that journal) to the effect that, as I read the announcement, it seemed to me that all the experience we had gained about such matters since the time of the Royal Commission of 1844, appeared to have been completely thrown away, adding a few general remarks upon the character of the proposal. It afterwards transpired, as the explanation, that for several sessions the Dover Harbour Board had endeavoured to obtain the sanction of Parliament for the extension of their harbour works; and as it was considered, and justly so, that such

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a measure might interfere prejudicially with the public value of the Admiralty Pier, the Government, on the 3rd of April, 1873, directed Sir John Hawkshaw, C.E., and Sir Andrew Clarke, R.E., "to consider whether any plan can be devised which will combine the naval and military requirements of Dover with the objects which the Dover Harbour Board propose to effect by their Bill now before Parliament." This instruction was followed some twenty days afterwards by a Report from these gentlemen, recommending, as was to be expected, the formation of a close-harbour of 350 acres in front of Dover—a sort of miniature of that of 1844, but very inferior to it in general arrangement. It was right to assume, that in a scheme involving the expenditure of a million of money, the public, who had to pay the cost, would have been favoured with such clear statements as to how the naval and military requirements were met by the proposal, as would afford an ample warrant for carrying it out. Instead of this being the case, the document was a bare recommendatory Report, and, what is especially remarkable, it contained no allusion whatever to the silty accumulation which would form within the harbour. This unsatisfactory character of the Report, however, was no bar to its adoption by the authorities, and, in due course, the heads of departments franked the scheme, as their predecessors did those at Alderney, Jersey, and Holyhead.

Owing to political changes, the measure was left as a legacy to the present Government, who, through the Board of Trade, introduced a Bill last session for carrying it out. A Committee of the House of Commons, presided over by Sir Seymour Fitzgerald, enquired into the matter, and there appeared before them, in support of the scheme, various chiefs of departments, headed

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by His Royal Highness the Duke of Cambridge, and also Sir John Hawkshaw and Mr. Edward Druce, civil engineers, who had a personal interest in its promotion. The writer was the sole witness against the measure, and his evidence was received at the request of Lieutenant-General Sir George Balfour, one of the members of the Committee, who, upon a careful examination of the apparent merits of the proposal, had previously opposed it in the House of Commons as unnecessary and wasteful.

Here it is necessary that we bear in mind the fact, that three special advantages were claimed for this national harbour at Dover by its advocates,—viz., that it would serve the purpose of international communication—that iron-clads could coal in it, and that troops intended for continental operations could embark from it. Most people will hold that it was not enough to show that these things could be done at Dover, but that, to avoid the chance of needless expenditure, the very first stage of the enquiry should have been to prove, beyond the shadow of a doubt, that it was impossible to effect these several purposes in its near neighbourhood; but it occasioned surprise when it appeared that this crucial point was not to be effectively enquired into. A few quotations from the published evidence upon this point will be sufficient: they are necessarily curtailed, to avoid repetition, but they represent the substance of what passed. The questions and answers occurred shortly after the writer had drawn the attention of the Committee to the fact that there was an unexceptionable station for coaling iron-clads only nine miles from Dover, and that in the Thames and Medway, within the distance of a few hours of steaming, we already possessed more

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accommodation for the embarkation of troops than we were ever likely to want. The numbers attached are those of the questions.

"1716. *Sir G. Balfour.*—Your object in giving evidence is that, seeing the country is to be put to an expenditure of one million sterling, you are desirous of showing that we have all the means existing at present, without the necessity of incurring that expenditure?—Yes.

"1717.—And you desire to bring in your evidence various other considerations which have not been brought before the Committee, so as to obviate the necessity of incurring that expenditure?—The only evidence I should give would be to show that the three objects proposed to be secured by the construction of the harbour are supplied in a better form elsewhere.

"1718. *Chairman.*—That is not the evidence we desire to have, and I point out that it is advisable for you to show that there is equal facility for coaling and the embarkation of troops in the Downs, which you say is only nine miles distant. You have given evidence as regards the coaling, but when you were asked with reference to the embarkation of troops, you went off to the Medway and the Thames, and we have heard nothing of the embarkation of troops in the Downs?—The only evidence I have come to give relates directly to the advisability or non-advisability of the adoption of the harbour; that is the only evidence I have prepared.

"1720.—Then as regards the embarkation of troops; if you can say that it is as easy and convenient, at all times of the tide and weather, and under all circumstances, in the Downs as it would be in the sheltered harbour of Dover Bay, we are ready to hear it.—The embarkation of troops has nothing whatever to do with the Downs; I merely want to show, from practical acquaintance, that you have, in places which cannot be molested, ample accommodation for the embarkation of a numerous army at any moment; and I want merely to have that fact brought into contrast with the embarkation of a body of troops at Dover, which may be molested.

"1721.—Are you, or not, prepared to say that there would be equal facilities at all times for embarking troops in the Downs, as there would be in the sheltered harbour of Dover Bay?—Not in the Downs, but elsewhere.

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"1723.—I ask you particularly with regard to the Downs; I understood you to say that it does not exist there?—The Downs are connected with the questions of a station for iron-clads and coaling; the near neighbourhood with that of the embarkation of troops."

This narrowing in of the scope of the enquiry can only be accounted for by supposing that the Committee were restricted by a limited reference; but it will be noticed by those who read the Blue Book, that no such limitation was imposed upon the witnesses who appeared to support the measure. The evidence upon the three points which I wished to bring before the Committee will be supplied here, and its trustworthiness can be readily sustained before any competent tribunal.

International Communication.—Facilities for international communication by steamers of large size and power are provided by the proposed harbour in the worst possible form, as it has the radical defect of confining their track to a comparatively narrow and frequented entrance, which would have a rapid tide-stream running across it, and the vessels keeping up the communication, especially after dusk, would be continually exposed to risk, detention, and damage. A free track, therefore, to and from the landing-place, to meet the constantly varying contingencies connected with vessels under-weigh and at anchor, is the very first necessity of the case. This the promoting engineer unwittingly admits, by stating to the Committee that he attaches great importance to keeping clear the entrance the international steamers would have to pass through—an arrangement which it would be utterly impossible to carry out in practice. The real solution of the difficulty is to be found, not in the obstructive cover of a

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great national port, as proposed, but in a modification and extension of the existing inner harbour, with a workable and sheltered entrance and passenger-mole near to the heel of the Admiralty Pier—an arrangement which would supply all that is really wanted for international communication, without interfering with the value of the Public Pier for purposes of war. Besides, it must not be forgotten that international communication itself, so far as it is connected with Dover, will become a matter of minor importance if Sir John Hawkshaw and his coworkers are able to carry out the Channel Tunnel, and measures now in operation would seem to prove that it is to be seriously attempted.

Coaling.—The Inner Downs, only nine miles from Dover, is an excellent station for iron-clads. In 1844, I gave some evidence before the Royal Commissioners of that day respecting a covering work near to it which it was proposed to form, but which was fortunately given up. At that time I had merely a limited acquaintance with the district, but in 1865 I made for the Admiralty a detailed survey of the whole sea-frontage between the North and South Forelands, and from observing the physical character of the Inner Downs, with its causes, and its perfect security in heavy weather, I became thoroughly impressed with its great public value. Defended and covered in seaward by two natural breakwaters, the Goodwin and the Brake, it is, to all intents and purposes, a harbour for vessels of size, and for general convenience and accessibility it is superior to anything which could be created by a costly outlay at Dover for answering the same purposes. The extensive anchorage outside

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it, the "Outer Downs," has been a station for numerous fleets from the time when Blake watched his Dutch antagonists from it down to 1832, when it served as a rendezvous for the combined squadrons of England and France, and when low and heavily armed corvettes of less than 500 tons' burden, (mere boxes of guns), experienced no difficulty in riding out the heavy gales of the winter of that year. Few nations possess a war-station in so commanding and convenient a position as that of the Downs, and the competing claims of Dover in this direction are altogether too flimsy to be entertained.

The Inner Downs has space for about 16 swinging berths for iron-clads, with ample depth and security at all states of the tide and weather, as small coasters, ill fitted and found, frequently ride out the heaviest gales in the same position. A fleet stationed here, being removed from the highway of the Downs, would cause no interference with its navigation, and it could slip on an emergency, and proceed on service by day or by night, and at times under circumstances when in a close-harbour at Dover it would be locked up in a trap, without the power of moving.

Coal could be put on board iron-clads in the Inner Downs by screw-colliers, from the Welsh and North-Eastern coal-ports, or from floating depôts supplied by railway, to be at their moorings in the Inner Downs when the fleet was present, and at Dover, Ramsgate, or other place of security, when it was absent. It is idle to contend that it would be difficult to carry out the operation of coaling in such a position, seeing that it could be done with certainty and dispatch under the lee of the iron-clad, when she was either tide-rode, or partially sprung in

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moderate weather, and at other times under the shelter of a bow-screen from the iron-clad; such screen forming part of the ship's equipage, and, like accommodation-ladders, to be put together and placed when needed. In my early days, I well remember that small sailing colliers had to pass, half loaded, over the shallow bars of their several harbours, and fill up their cargoes in the roadsteads outside, exposed to every casualty—and yet they did it; and now to contend that an enormous iron-clad, a town in size, by comparison, with full command over her own movements, must be sheltered and covered in by a stone mole to enable her to go through the same operation, is not very flattering to the resources of the naval officer of the present day.

Embarkation of Troops.—While pointing out that a harbour at Dover would be of use for embarking an army for the Continent, the Duke of Cambridge said, very candidly, that it was likely we may never be called upon to send an expedition anywhere. Admitting, however, this event to take place, we have at the present moment, connected with the military centres of Canterbury, Maidstone, Sheerness, Chatham, Woolwich, London, and Colchester, invaluable embarking-places, with 50 to 18 feet at low water, at Sheerness, Gillingham, and Chatham, on the river Medway; at Southend, Thames-Haven, Gravesend (north and south), Greenhithe, Erith, and Woolwich, on the river Thames, and at Harwich in Essex. All that is needed to render them at once available might be supplied in a few days, and would consist of short tramways, in several of the cases, to connect the railways from the military centres with the embarking-places, and pontoons formed of gangways laid across the decks of the

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flat-bottomed barges which abound in these localities, and which are admirably fitted for the purpose. The expeditionary transports, having received their heavy material at the arsenals at Chatham or Woolwich, would drop down to the several shipping-places in succession, embark their quota of troops with their light artillery and baggage, and then rendezvous at the Nore, or in the Downs, a few hours afterwards. Any advantage which Dover, from its advanced position, might have claimed as a point of departure for the sailing transports of a former period, is entirely done away with now that steam has bridged over distance. The Commander-in-Chief remarked in his evidence, that, in embarking troops, it is essential you should have great security: this is amply insured in the places indicated, as embarkation could go on without even the remotest chance of interruption by an enemy. Not so with Dover: a harbour there, packed as it must needs be by the vessels conveying an expeditionary army, would supply an enterprising enemy with just such a chance as experience proves would be taken advantage of; for a hostile vessel, especially at night, could neither be prevented from entering the harbour, nor controlled by artillery when there, and dealing destruction among the defenceless transports with their living freights confined within it. To enlarge upon this subject would be out of place, but what has been said will be suggestive to those who can give to the question the benefit of an unprejudiced judgment.

If the foregoing views on these three points can be substantiated, as they assuredly may be, they are fatal to this project at Dover; but one of the most important points connected with it, that of silting, has yet to be noticed.

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Silting.—The special drawback attached to close-harbours is the deposition of the detrital matter with which sea-water, in the vicinity of a coast, is always more or less charged. It has been mentioned that the recent Reporters in favour of a harbour at Dover entirely ignored this feature of the case, and their silence is the more noteworthy from the fact, that the Royal Commissioners of 1844 left the following record of their opinion upon this point. They remark respecting a possible freedom from silting:—

> "It is not our intention to contend for what is, in truth, practically impossible, as it is manifest that the greater part of whatever sedimentary matter may be held in the water flowing into a harbour will fall to the bottom with more or less rapidity in proportion to the stillness of the water within, and only such portion of the lighter matter as, from its less specific gravity, may remain in suspension, will be carried out by the ebbing tide."

A similar caution upon this point supplied by the Committee of 1865 was equally passed over, but, fortunately for the public, it has not yet been forgotten it was owing to partial Reports of this kind that loss was suffered at Alderney and Jersey.

There is no difficulty whatever in comprehending this process of silting; the law which determines it is briefly stated in a Report from the writer to the Secretary of the Admiralty more than twenty years ago, when dealing with a proposed close-harbour at Hartlepool, similar to that which has now been recommended for Dover. I remark in the Report:—

> "The great agents of change upon all sea-boards are the waves and the currents, tidal or otherwise; the former in destroying and disturbing, the latter in suspending and transporting, and the various modifications of these mechanical processes are all apparent to common observation. Matter suspended in water, and depending on motion for its support, is

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deposited upon entering a harbour or other sheltered place, the time in which it is so deposited depending on the gravity of the matter, the repose of the water, and the depth of the descent; and, as a general fact (with singularly few exceptions), these accumulations gradually increase in all close-harbours, or still-water basins, according to the varied circumstances of exposure, surrounding matter, extent of surface, and depth."

This process of alternate suspension and deposition is always going on upon every sea-board, and, where not interfered with by artificial works, the features of the foreshores remain unchanged; the equilibrium, in short, is preserved, and the amount of soil upon the foreshore will neither increase nor decrease by any sensible amount. Directly, however, a portion of the frontage is enclosed, and cut off from this mechanical action of wave and current, the circumstances are altogether altered—a fact which has been but too frequently disregarded in harbour projection.

Examples wherein this law of suspension has been destroyed by artificial works, with the effects which have followed, are invaluable as guides, and a few will be given, although the number available for the purpose is very considerable.

Ramsgate Harbour, formed over a site which originally was as free from deposit as Dover Bay is at present, has long enclosed nearly a dry waste of mud and sand.

The frontage of Lowestoft was originally quite free from accumulation, but in two and a half years after the harbour was formed, it filled up from six to ten feet in its deeper portions—a result which was predicted by the writer, as well as another evil which has since followed, viz., the advance outwards of the northern beach, and the consequent tendency to create a bar

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across the harbour-mouth. At present a channel is maintained through the harbour by periodical dredging.

The foreshore of Grimsby had a permanent character before the dock-works were formed, although it was daily covered by water heavily charged with floatable matter; but now it is difficult, even by sluicing and dredging, to keep under control the mud which forms within the basin.

The public harbour of Howth, north of Dublin Bay, has long been nearly sanded up, from its having been formed without a due regard to adjoining features. It cost half a million of money, and was intended for a packet-station; now it harbours only a few small fishing-craft.

Three years after sluicing was discontinued as a means of maintaining depth in the basin at Birkenhead, 9 feet 8 inches of deposit was found to have formed in it.

When the writer surveyed Holyhead Harbour in 1857, the depth had been reduced by 15 to 18 inches of deposit.

It is believed that the same tendency to fill up has been developed at Portland Harbour, which is not entirely a close one; a bank has also grown up under the partial cover afforded by Plymouth Breakwater, and even Kingston Harbour accretes slowly, although, from the nature of the adjoining coast, it is filled with comparatively pure water.

The foregoing examples are sufficient for present purposes, for they conclusively show, that in cases embracing every physical variety, the waters quickly gave up the detrital matter they were charged with, when wave and current were intercepted by artificial works; showing that the previous permanence of feature in these cases was not due to the want of suspended

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matter for producing change, a mistake very commonly made, but only to the non-establishment of conditions favourable to deposit. In harmony with this it may be remarked, that no natural feature analogous in form to a close-harbour exists in any situation where the water is charged by matter, except it be in a choked state.

The application of the foregoing to the case of the projected harbour at Dover is obvious. The harbour, as in the cases above cited, would be a close one—that is to say, the wave and current action would be entirely intercepted and destroyed by the covering breakwaters, and, excepting the miniature surface-motion which the harbour expanse would admit of being generated, perfect stillness would be the result; taking into consideration also that the water along the littoral at Dover is generally charged with suspended matter, the conditions for aggravated accretion would be established. The Commissioners of 1844, fully sensible of the important bearing of this fact upon the subject of their enquiry, tried to determine the amount of floatable matter in Dover Bay water by observations made under the direction of the late Admiral Washington, one of the members of the Commission. The results were various. On a calm day, during a spring-tide, for example, the matter suspended in the water of the Bay was three times the amount found in Thames water above-bridge when no rain had fallen for a month, the mean sea and river impurities being respectively 8·11 grains and 2·57 grains per cubic foot, or in the relative proportions of 16 to 5, the sea material being sand and chalk, with some vegetable matter. In a strong N.N.W. wind, no less than 473 grains were found suspended in a cubic foot, and the average of the observations, rejecting

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extremes, was $33\frac{8}{10}$ grains; including them, $51\frac{1}{2}$ grains, or twenty times the amount found in Thames water in its most charged state prior to the establishment of the metropolitan drainage system! If all was deposited, the larger quantity would represent $77\frac{1}{2}$lbs., and the smaller quantity $51\frac{1}{2}$lbs. of deposit per annum upon each square foot of surface; and, as it was found by experiment that a cubic foot of silt weighs 103lbs., it follows that the larger quantity would yield a thickness of 9 inches, and the smaller a thickness of 6 inches of solid deposit annually over the whole harbour. Prudence requires that the extremes be included in the average, especially as experiments proved that molecular transmission of some of the matter in Dover Bay water is exceedingly rapid. It is to be noted, that Admiral Washington made other testing observations between February and September following, which yielded 5 inches as the probable amount of accretion; but as these observations did not extend through the winter months, when gales suspend the maximum amount of matter, I prefer basing my deductions upon the Admiral's first results—a preference which my late esteemed chief would have been the first to recommend.

It is admitted that it would be very difficult, if not impossible, to predict with certainty the annual loss of depth from deposit in a close-harbour at Dover. Here it will be useful to make a quotation from my pamphlet of 1858. On pp. 36, 37, I mentioned, that in giving evidence before the Commissioners of 1844, I said, in answer to a question about the probable silting in a close-harbour at Dover:—

> "'It would share with Ramsgate in this particular, but in a less degree at Dover, as it would have a greater space to fall through before being deposited.'

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"A more extended experience, however, has led the writer to doubt the entire soundness of the opinion he then expressed, for he has since observed, in the examination of several deep-water harbours, that the greatest quantity of deposit always occurs in the deepest portions, and that it should be so, will be manifest after a little reflection. It has been explained (p. 7), that the extent of the sub-action of a wave bears a certain proportion to its magnitude, and also, on p. 31, that a 6-feet wave on the east coast of England will disturb matter at a depth of 6 fathoms, which is six times the perpendicular measure of the wave itself. Now, allowing it to be possible for a 3-feet wave to be generated within the space of a refuge-harbour like that of Dover, then, if we are correct in adopting the above proportion to determine the limits of disturbance, it will result, that under the depth of 18 feet below the low-water surface there will be a region of motionless water, to which matter will be constantly committed from the super-imposed water, and through which it must fall to the bottom, where, not being subject to any disturbing influence, it will remain as a permanent deposit; and, on the other hand, that where the water has a less depth than 18 feet, material which has been deposited during a period of rest will be liable to be turned up and borne elsewhere. Thus, the quantity of matter remaining after a given time, will be greatest in the deeper portions of the space."

As to the amount of accretion in a close-harbour at Dover, my belief is that it would not be less than 9 inches per annum, the maximum result of Admiral Washington's experiments; but to avoid the chance of overstating the case, I shall adopt 6 inches, or his smaller quantity, as representing the annual loss of depth. Several engineers of the greatest experience in the operation of dredging agree with the late Mr. Walker, that lifting and depositing in such an exceptional depth as that of a national harbour at Dover could not be done for less than a shilling per cube yard. Sir John Coode would appear to confirm this estimate, for he stated in a paper read at the United Service Institution, that "if a national harbour, wherein you require something like 5 or 6 fathoms of water, has to be dredged, it is a very formidable business, but it can be done. It is simply a question

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of money." It follows, then, that to lift 6 inches of deposit from 350 acres of surface at a shilling per cube yard, would cost (exclusive of the sum of £35,000 or £40,000 for plant), £14,000 per annum for keeping the harbour open—not a great sum for a national exchequer to bear; but if the words "for ever" be added to it, then the character of the proposed financial burden becomes apparent in all its ugliness.

How is this important matter of silting met by the promoting engineer? First of all, by evidence which, to say the least of it, mixes up very singularly the operation of silting in Dover Bay with the movements of shingle; the features of Dungeness and St. Margaret's Bay; the attrition of the coast on either side, and their loss and gain, and the rotatory stream and the movement of the coarser particles in Dover Bay, adverted to in my official Reports—points very interesting in themselves, as showing, in part, the cause of the charged character of the water, but which have nothing whatever to do with the deposition of the lighter particles of matter, or "silting," a process which cannot take place in any aggravated degree until Dover Bay, by covering works, is converted into a clarifying pool and mud-trap. Then there were the hopeful anticipations:—"My own opinion is, that the silting will be very small."—"I do not believe, if the harbour were constructed, that there would be more silting than there is at present."—"I won't say there would be absolutely none."—"I don't say it would be less than nothing," &c., &c. Such vague expressions as these will scarcely be accepted as conclusive, or assuring, by those who are called upon to provide the cost of the harbour, the more so, as not a single example is adduced as a warrant for the belief, and as a partial set-off to

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the striking ones already described which prove its fallacy. True, that some stress is laid upon the fact that the present inner harbour at Dover has been less troubled by accumulation of soil as the Admiralty Pier has been advanced seaward—an effect undoubtedly owing either to the larger number of steamers frequenting the port, and the resulting suspension of matter; to more internal motion in easterly winds, by the harbour being converted into a sort of *cul de sac* by the protrusion of the Admiralty Pier, or, possibly, to the harbour receiving clearer water, owing to the same work deflecting away from it the heavily charged in-shore stream. Whether due to one of these causes, or to all of them combined, it is clear that none of them are applicable to the larger close-harbour, and no conclusion favourable to the latter can be based upon them.

Worked-out examples are stubborn things, and are awkwardly in the way of projectors at times; but they are, in short, the only safe guides to a sound conclusion in such a matter as this, and no thoughtful and impartial person will contest the inference that, as a perfect identity exists between Dover and those places where material loss of depth by accretion has taken place, like results would again follow. It will also be considered that to destroy by artificial works the operation of an active and conservative law of alternate suspension and deposition, and then to expect to escape the penalty of doing so, is as unwise as the result would be disappointing. So far as regards silting.

The military evidence also supplies one or two points worthy of comment. The military witnesses appeared to be attracted by the idea of a harbour at Dover, owing to the place being well

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fortified, and having been made a sort of "British Gibraltar," as it is termed. But what did the Commissioners of 1859, and a similar reporting body ten years afterwards, say about these same fortifications? "That if there were no works of defence or military establishments there already, . . . it would become a question whether that place should, or should not, be fortified;" though, under the circumstances, they were of opinion "that no other course was open but to complete the works in progress, and give them such additional strength as may be necessary to render them secure." To a looker-on, it is difficult to conceive the use this "British Gibraltar" could be put to, except, perhaps, as a place of retreat for a British army defeated on its own soil—a contingency which does not appear to be one of urgency! As for an enemy attempting a landing on the spot, the idea is simply preposterous. Julius Cæsar did not approve of the frontage of cliff-bound Dover for the purpose, even without its guns, and, like a sensible man, he went to the westward, the declination of the land in that direction affording a probability of a better landing-place; and recent researches go to prove that he found it in the shingle-beach in the neighbourhood of Hythe. Any commander of the present day would exercise a like discretion, did he meditate the folly of attempting a landing in force on our shores. Another military idea in support of a harbour at Dover Bay—that it would afford a British squadron a place of retreat, so as "to avoid the danger of being surprised by a superior fleet"—is one that may, without presumption, be permanently shelved with that of a lost "Battle of Dorking." It would, of a truth, be humbling to our pride, and destructive of our prestige in the opinion of foreigners, did we commit the

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double blunder of fronting misplaced fortifications by a harbour which experience proved to be equally useless.

The aggregate of £970,000 was the estimate for the scheme depicted in the cartoon on the wall of the Committee-room, which was supposed to embody the combined ideas of the reporters. Considering the financial stake involved, and that it had the definite object of providing for our "naval and military requirements," it was but natural to expect that this plan was the result of a most careful consideration of all the circumstances of the case; but an improved harbour, both in area and the position and width of entrance, had to be conceived in the Committee-room, as it gradually became evident that the one exhibited would only imperfectly serve the various purposes for which it was intended. It was quite clear, that if the harbour was to be made at all, the area would have to be increased by materially altering the direction of the eastern breakwater, and this alone, it appears, would add £154,000 to the estimate. In reference to this feature of the case, viz., the fact that estimates were enormously exceeded in the formation of public harbours, I remarked, in answer to question 1988:—

> "I already perceive that the process which led to increased expenditure in the case of Alderney would inevitably follow in the case of Dover. I observe that the eastern pier would have to be extended; you will have to narrow the entrance, and this will increase the expenditure; then you will have to provide for the fortifications, and that will increase the expenditure. A fort is required for the coaling station, and that will increase the expenditure; and although the increase over the original estimate may not be equal to that at Alderney, no doubt the total will involve much more than the expenditure stated in the estimate for this harbour."

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The financial history of these public schemes is, in truth, very instructive—the estimated and actual costs of Alderney, for example, were £300,000 and £1,274,000; of Holyhead, £628,063 and £1,285,000; and even Portland, so well carried out and completed by my esteemed friend Sir John Coode, forms no exception to this rule of excess, as the estimated and actual costs for it were £588,959 and £1,033,000. It is very possible that the Committee were not fully aware that this is a common feature of such cases.

One more point before we pass on. It is difficult to divine the initial cause of this renewal of an old project, for, in the writer's opinion, there are other special considerations supplying ample reasons why a harbour at Dover should not be formed. In the 280 miles of coast between Cherbourg and the river Schelde, there are only the inferior harbours of Havre, Boulogne, Calais, Dunkirk, and Ostend, not one of them fitted to receive an iron-clad, and there has been no proposal to form one for such a purpose, to which that at Dover would be a sort of "check-mate;" while upon our own coast opposite, in less than half the distance, we have several minor harbours quite equal to the continental ports just named, besides the Downs, and the Admiralty Pier at Dover—a work which, while it possesses the convenience of a harbour without its expense, is at the same time fitted to answer most of the naval requirements of the district in a time of war.

Such are the leading facts which tell against the adoption of this scheme at Dover. The Committee did their best; they were,

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for the most part, dealing with a question foreign to their common experience, and it being difficult, in consequence, to test the value of the statements made before them, a majority of the Committee reported in favour of the Bill, but the Government withdrew it, without subjecting it to the ordeal of a third reading in the House of Commons, and a Committee of the House of Lords. Shortly afterwards, the Duke of Richmond stated in reply to a question of Earl Granville's respecting it, that the Government "thought it better to withdraw the Bill for the present session, in order that they might in the autumn thoroughly sift the evidence, and prepare a plan to submit to Parliament next session. In making this statement, he did not pledge the Government to any particular scheme, but wished to show their Lordships that the Bill was not withdrawn with any view of shelving the matter in any way whatever." Hence the origin of, and the necessity for, the present pamphlet.

To recapitulate. It has now been pointed out what the present system of harbour-legislation involves. It has been shown that, at a sacrifice of several millions sterling, we have obtained at Alderney a wretched enclosure where it was not wanted, fitted neither for refuge nor for war; that we have abandoned at Jersey another harbour when the circuit of its works was partly completed; that at Holyhead we have formed one nautically defective over a site where a shorter and cheaper work would have enclosed a superior one, and now at Dover the authorities appear to be quite ready to incur a large outlay for a harbour where one ought not to be formed, because it is for purposes

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which can be far better served in its near neighbourhood at little cost. In the several worked-out examples, money has been wasted—predictions have been falsified—and, at their initiatory stages, the public have been misled by estimates which were trifling in amount when compared with the ultimate expenditure.

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THE CAUSE.

WERE the foregoing serious failures owing to a want of existing information? Certainly not. It was well known thirty years ago (to take one example only) that a harbour on the weather-side of an exposed island, with its entrance swept by a dangerous tide-race, was not a place for common use, and still less for refuge. Increased light was not needed to discover that ground broken up by rocks protruding 12 to 18 feet above the general level was not exactly adapted for the convenient and safe berthage of ships of war of heavy draught; more light was not wanted to prove that a breakwater with a kant in it, exposed to the batter of a destructive sea, would be difficult to construct, and more so to maintain; above all, the light existing in 1845 was quite sufficient to have suggested the fact, that two or three vessels of war in a harbour at Alderney were not very effectual as checks to a French fleet in Cherbourg, 23 miles off, especially as this celebrated naval rendezvous was masked by an intervening Cape, and could not be seen! Of course it will be said, this is an *ex post facto* criticism, and one easily made; but what experienced and candid person can for a moment deny that the same strictures might as readily have been supplied when the unfortunate enclosure was first meditated, and before a single stone for it had been quarried?

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The reason of all this is quite upon the surface; it is, in fact, the direct result of our foolish custom of allowing these matters to be principally decided by persons who have a personal stake in the proposals, and who, from circumstances, are unable to deal with them. Here let me not be mistaken. Being an Associate of the Institution of Civil Engineers, and having many friends of long standing enrolled among its members, it will be readily understood that in what follows, nothing can be further from the wish and the intention of the writer than to cast, by implication or otherwise, a slur upon their noble profession, and especially upon those members of it who stand high in general estimation; to do so, would be as undeserved on their part, as it would be utterly presumptuous on mine. The writer, in truth, yields to no one in his admiration of the talent of the men who have conceived and constructed those stupendous engineering works which constitute their abiding monuments, and mark the age in which we live; but it would be trifling with the question we are considering, were any point omitted which is calculated to throw light upon it.

It has already been said that the question of public harbours is generally decided by the wrong persons, and we will take this case of Dover as an illustration, for it is fairly typical of the existing system. In legislating for a national harbour at this place, testimony of a thoroughly independent character was a necessity; but what have we here? Exclusive of the departmental evidence, two professional witnesses only were called before the Committee; the one had already reported in favour of the harbour, and, in accordance with precedent, would have to superintend its formation, if adopted; to the other, the con-

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struction of its works would probably provide a life-employment. To place these gentlemen in such a position was unfair to them, and doubly so to the public. No judge willingly remains on the bench after a case in which he is personally interested comes on for hearing: the wisdom of this is self-evident, and it is to be regretted that a similar wise caution was not observed in the Dover enquiry. A personal stake, as we know, is not the best help in prompting a judicial deliverance, for, as has been well said, "a man's judgment leans sadly over to the side of his own interest." Such is human nature as we experience it, and observe it, and the gentlemen referred to will scarcely claim to be above its operation. It will doubtless be felt by lovers of fair-dealing, that their position with respect to the enquiry deprived their statements of the value which they might otherwise have claimed.

Then, as regards competency. We all know that the selection of a proper site for a national harbour, with its projection, is a complex question, embracing as it does military, naval, strategical, nautical and physical considerations of the highest importance, all of which ought to be thoroughly sifted and weighed in the light of experience, before a decision is arrived at. Such is the problem to be solved, and it is contended that no engineer, be he civil or military, is fitted to deal with it single-handed: it is not his province, and experience conclusively proves it is not within his power. In the common practice of the engineer, public harbour questions are entirely exceptional, and his proper function in such cases is to design and to construct the works only, and not to determine either the place or the form of the harbour—a doctrine which may be

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considered novel by those who now hear it for the first time, but I have always held it as one that could be readily maintained. How can an engineer, for example, deal with the nautical question alone? The geographical situation of a site, in connection with its exposure and nautical availability at times of weather and sea stress—the position and the general arrangement of the entrance, or entrances, of a harbour, for meeting all the contingencies which are likely to occur to vessels entering under sail and steam—are questions, among many of a similar order, which enter directly into harbour projection, but which can scarcely be said to be within the scope of the personal experience of the civil engineer. It is very much the same with the physical points; for an engineer in extensive practice, with his mind thoroughly absorbed in carrying out works of the most diverse order, has far too little leisure, even if he had the means, for obtaining and generalising the facts connected with those laws and their local modifications which enter directly and intimately into the same question. To say that an engineer can procure his information from nautical and other adepts in such matters, amounts to nothing in the way of solution, for if the subject of enquiry is foreign to the engineer's experience, it is quite impossible for him to determine the value of the information he receives, and he is thus constantly exposed to the risk of being misled by the parties on whom he relies for supplying his deficiency. The radical changes in design at Alderney, Jersey, and Holyhead, already adverted to, show that these questions, as at present decided, appear to be surrounded by a sort of "Cimmerian darkness;" and Mr. Redman, civil engineer, whose researches into the movements of shingle are well known, called

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attention to this noticeable feature in a lecture on the "Enclosure of Dover Bay," lately delivered in the United Service Institution. While adverting to the present design for Dover, and its variation from those which preceded it, he remarked :— "No less than three designs have appeared for this retrenched area of enclosure, and all emanating from the same quarter. In one case, with a single south-west entrance of 550 feet; in another, a similar south-west entrance and an eastern one of 300 feet only; whilst in the last design we have a south-west entrance as before, with 800 feet of eastern entrance, and that at a point where all the other enquiries placed the smaller entrance. This fact, that the entrance space is already doubled by the authors of the modern design consequent on two years' deliberation, would apparently tempt one to draw the conclusion, that a continuation of their studies might produce a similar happy result as regards the enclosure area." Professor Robison and the late Sir William Fairbairn drew attention in their writings to this same feature of "groping the way," as they term it, and there can be little doubt that engineers would gladly escape from the dilemma forced upon them by professional custom, and our blind adherence to precedent, in this matter of public harbour projection.

It will not do also to attach too much importance to the departmental aid, by evidence and otherwise, which this Dover scheme has received, if the teaching of the past is to have any weight. When such action is the result of local examination and experience, and a long and thorough acquaintance with the subjects dealt with, it is, of course, deserving of attention; but when, as is often the case, it is a mere *ex cathedra* utterance,

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it is entirely out of place, and is calculated to mislead rather than to be useful. Besides, to look at the matter in a general point of view; a check to an unwise step on the part of Government can scarcely be expected from its own servants: if applied at all, it must necessarily be by some outside, and thoroughly independent authority.

It may be observed here, that private-Bill legislation has scarcely anything in common with the process which has now been generally described. In the former case, the inhabitants of the locality interested in the proposal know all about it—the persons favourable and opposed to its prosecution are in court, and appear by their counsel—witnesses for and against are fully heard—the character of the project is developed stage by stage, and these several checks upon the working of an otherwise defective machinery are held to be sufficient to insure a correct verdict being arrived at in the majority of instances. In the case of these more costly public measures, on the contrary, the public are not in court, for they are decided substantially by the Government authorities and their "advisers;" there is, in fact, an entire absence of proper control over them, except that which may haply be supplied by the imperfect and uncertain ordeal of votes in the Houses of Parliament. The Government is not to be blamed for this for one moment; there does not exist any Board, or other cognate authority, possessing the requisite theoretical and practical information to which the case may be referred, and whatever may be the desire of the authorities to know the truth about the schemes pressing for their support, they can only employ for the purpose the defective machinery which custom has established.

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To show that the case, as pourtrayed, is not overstated, it is only necessary to draw attention to the views entertained on the subject by one or two Government servants, and which are contained in the Report of the Royal Commission of Enquiry into Scientific Instruction and the Advancement of Science, lately made public. Among others, Captain Douglas Galton, of the Office of Works, complains "that statesmen do not properly appreciate the value of scientific advice, or scientific enquiry, and are very much fonder of experiments made upon a large scale with no defined system, than they are of experiments which have been brought out as the result of a carefully studied previous enquiry." Mr. Anderson also, the Superintendent of Machinery at Woolwich, who has been responsible for the expenditure of very nearly £3,000,000 of public money, pointed out with regard to his own department, "There is a great deal which I should like to see taken in hand systematically. We are groping in the dark in almost everything at present." In reporting upon the whole question, the Commissioners were unanimous in stating, that "Even in the interests of the departments themselves, more ought to be done by the Government in the way of investigation, particularly in respect to those sciences the practical application of which has been developed, or the scope of which has been enlarged, within recent years." It will be observed that, practically speaking, every word of the foregoing is directly applicable to the case we have been considering.

Much more might be said upon the subject, but only one other point will be adverted to. We have seen what is involved by allowing the selection of sites for public harbours and their formation to depend upon the *ipse dixit* of a single engineer, and

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it will not have escaped notice as a feature of these cases, that death generally removes from the scene those whose advice has been followed before the facts are fully known, and the mistakes are accomplished. How often also is it remarked, in connection with these failures—"It is true that our predecessors made blunders; but let bygones be bygones, as we are not likely to repeat them." But this will scarcely be admitted by those who have read the foregoing narrative of the Dover case attentively, for if there is one thing in it more apparent than another it is, that the same system of harbour-legislation which has been so disastrous in former days is still in full operation, and the men for carrying it out only are different—the performance in all its parts is exactly the same, while the actors alone have been changed.

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THE REMEDY.

TO pull down, rather than to build up, is the easy process; it is far from difficult to detect and to arraign a faulty system by holding up to view the character of its defects with their practical result, but it is not quite so simple a matter to call into existence a better one to supersede it. To do this effectually needs much enquiry, full information, and mature consideration; and, above all, such consideration must be preceded by an intimate acquaintance with the working of the departmental machinery of our governmental system, so as to prevent collision with the new body, and insure harmonious working. Still, by keeping one or two leading principles in view, it ought not to be difficult to conceive a way of removing the cause of the evils which have been pointed out.

There can be little doubt upon any one's mind, that the custom of referring public harbour questions to improvised Committees and Commissioners ought at once to be given up; it is a clumsy expedient and a "leap in the dark" at the best; and, as Carlyle says, "it leaves such questions in the saddest conflict of uncertainties." When the members of such bodies are selected for this duty, not because of their fitness for grappling successfully with the questions submitted to them, but only for their "accidents" of place and name, need we wonder that crude

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schemes are promoted at times, with only a bare chance of successful challenge?

To be brief. That which has been already described as involved in the selection and projection of a public harbour, suggests the composition of the proper court for dealing with it. As the subject embraces naval, military, strategical, nautical, and physical considerations, as well as that of marine construction, each of these branches of professional knowledge ought to have two or more representatives in a permanent body to be termed the "Referees for Government Works," to be called together and to be paid only at such times as it might be necessary to submit questions for their consideration. The appointment to such a court of examiners, though by no means a lucrative one, would be regarded as an honourable position, from being an acknowledgement of professional standing. The Referees being placed under the most solemn obligation respecting the discharge of their duties, would (like our judges) be removed from the risk of having their minds influenced by *ex parte* statements upon pending questions—an advantage which will recommend itself to those who are usually mixed up with such matters. The members of such a court, in their several departments, would quickly formulate general principles for their guidance, and which would be applicable for a decision upon the cases brought before them. So long also as Parliament retains in its hands the power of dealing with professional questions by committees of its own body, sections of this same Court of Referees might be called upon to aid towards a correct finding upon those special points which are continually cropping up in our maritime country.

As the foregoing proposal is advanced as a mere suggestion,

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it is useless to enlarge upon it. Allowing it to be possible, however, to establish some such court, our harbour-legislation in future would, for the first time, be placed upon an intelligible basis, and in return for an occasional small outlay, we should be saved from the risk we now incur of expending millions of the public and other moneys upon unnecessary and useless works.

In conclusion.—The subject is of public importance, and is therefore worthy of the serious attention of the Government. Let but this worthless scheme at Dover be adopted, and it will be immediately followed by demands for similar harbours at Filey, Lundy Island, and other places; an appearance has already been put in for them, and they are merely biding their time. Doubtless the same attractive pleas which have hitherto misled the public would again be urged on their behalf, viz., that they are a necessity for "our first line of defence"—"for the purposes of strategy"—"as coaling stations"—"as centres of defence"—"as bases for naval operations"—"as points of observation of the movements of an enemy," and so forth—ideas which may possibly address themselves to the "traditions of the elders," but which have no more to do with the operations of a future naval war, if it be forced upon us, than has the lightning-like passage of an express train with the lumbering movements of an old stage-waggon. Judging by past experience, fully a million and a half sterling will be sunk in this Dover project alone, if it be allowed to be carried out; but how much better would it be for the interest of the nation were the same sum advanced at low interest, to supplement local efforts for the improvement of our small but numerous harbours, especially as it is becoming

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increasingly apparent that it is upon these harbours, and these only, that we shall (by preference) eventually depend as stations for effective means of national defence.

One word must here be offered about iron-clads, but only a word, though it will scarcely be considered a digression when it is remembered, that one of the principal reasons advanced for the enclosure of Dover Bay is connected with the accommodation of these vessels. It would seem to be particularly unwise at this day to provide special harbours for iron-clads, as these monster vessels, though well fitted to adorn a pageant from their possessing the semblance of force, are comparatively useless for home defence. Without enlarging upon the point, it may be mentioned that their great length and depth would prevent the possibility of their moving freely in our narrow and shallow navigations, and, even if they were efficient in other respects, (which they are not,) their costliness alone, both in money and men, would prevent our producing and maintaining a sufficient number of them to protect the 2,500 miles of the sea-board of Great Britain and Ireland, every mile of which is open to predatory attack in these days of steam. As the truth of this cannot be ignored, and is beginning to be generally recognised, there can be little doubt that the iron-clad of the present day will speedily disappear before our necessity and modern invention. This is no "new light" of mine, for personal friends and others are well aware that I deeply regretted their introduction from the very first, and principally because it seemed to be the result of a blind following of the lead of our neighbours across the Channel, and of failing to perceive, when the introduction of steam had necessarily revolutionised the general operations of war, that

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size was no longer synonymous with power. At the United Service Institution, a few months ago, Admiral Sir Henry Codrington epitomised the whole matter of home defence in a sentence or two. He said, "Our forces are mostly massed at the large ports, but what is to become of the small ports, which were so advantageous in previous days in making the commerce of England? . . . it grieves me to see the way in which they have been allowed to go to the bad and silt up, for the want of the commonest energy to keep them clear . . . we want a force to be on the spot wherever an enemy may attempt to set his foot, so that he may be prevented from making a lodgement until we can bring down our military from the military centres." This is not the place to enlarge upon this interesting and important subject, but in adopting means for the most vital of all the points of national defence—that of the complete security of our own shores—the foregoing principle of local availability is the one to keep steadily in view, and the sooner our rulers recognise this, and act upon it, the better it will be for our present and future interests.

Lastly.—It was observed at the opening of this exposition, and it cannot be too much insisted upon, that the multiplication of public harbours is essentially a case for the tax-payers to enquire into. Public works are large and costly, and they are as attractive as they are costly. How fortunate, for instance, were the men considered upon whom devolved the occupation of casting the mountain-like masses of stone into the sea at the Channel Islands, at a comfortable price per ton; and can we wonder that others would like to have some experience of the

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"refreshers" of periodical payments for carrying on a like agreeable process? It is, however, for the general community to disappoint any such expectation, by insisting, through their parliamentary representatives, that public works are to have a public value, and that the interests of the many are not to be subordinated to those of the few.

THE GRANGE, REDHILL:

January 1st, 1876.

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ERRATUM.

Page 14, line 7 from foot of page, *for* £1,400,000 *read* £1,285,000.

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BY THE SAME.

THE

CONSERVATION AND IMPROVEMENT

OF

TIDAL RIVERS,

CONSIDERED PRINCIPALLY WITH REFERENCE TO THEIR TIDAL AND FLUVIAL POWERS.

London: John Weale, 59, High Holborn.
1853.

ON THE

CONSTRUCTION AND PRINCIPLE

OF A

WAVE SCREEN,

DESIGNED FOR THE FORMATION OF HARBOURS OF REFUGE.

London: John Weale, 59, High Holborn.
1858.

REMARKS

ON THE

PROPOSED NATIONAL HARBOUR

AT

DOVER.

London: P. S. King, Parliamentary Bookseller, King Street, Westminster.
1875.

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REDHILL:
HENRY SUTTON, PRINTER,
3, STATION ROAD.

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