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AN EXPOSITION
OF THE
ERRORS AND FALLACIES
IN
Rear-Admiral Ammen's Pamphlet

ENTITLED

"THE CERTAINTY OF THE NICARAGUA CANAL CONTRASTED WITH THE
UNCERTAINTIES OF THE EADS SHIP RAILWAY."

BY E. L. CORTHELL, C. E.

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1886.

AN EXPOSITION
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Errors and Fallacies in Rear-Admiral Ammen's Pamphlet
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OF THE EADS SHIP RAILWAY."

It is to be regretted that an officer of high rank in the United States Navy should descend to such undignified personalities as appear throughout the recent pamphlet of Rear-Admiral Ammen, entitled "The Certainty of the Nicaragua Canal contrasted with the Uncertainties of the Eads Ship Railway."

It is not the purpose of the writer to descend to such a level in discussing this subject, but to point out briefly some of the labored misstatements and distortions of facts that everywhere appear in the pamphlet mentioned. Its extensive circulation in Congress, for the purpose of defeating the Ship Railway bill, makes it necessary to point out the Admiral's misstatements.

The frontispiece of his pamphlet represents the American Isthmus at Nicaragua as *lately reconstructed to suit the plans* of Engineer Menocal, with its water level raised and extended and its irregularities toned down by the contemplated canal construction. The profile as given of the Tehuantepec Isthmus, however, shows nature in her wild state, unmodified by

sion of broad valleys formed by the Jumuapa, Sarabia, Malatengo, and Chichihua rivers; between these valleys there are extensive table-lands, with no high or prominent dividing summit between them, but they are interspersed with isolated hills and detached ranges from one to five hundred feet in height, the whole forming an extensive interior basin, having a gentle inclination towards the summit, and bordered on its eastern and western sides by irregular mountain ranges, spurs of the main Cordillera that runs through the entire continent, and which makes at this point one of the most marked depressions to be found in its whole length. From this basin the line passes through a valley formed by a stream called the Pozo de Agua, to the plains of Tarifa, an elevated level plateau six miles in extent. Crossing these plains, the line reaches the Portillo de Tarifa, the lowest and also the most accessible of the many passes through this general depression in the main mountain chain. From the Portillo de Tarifa the line descends to the Pacific plains (reaching them 118 miles from Minatitlan) by a uniform grade," [1 foot in 100 feet, or $52\frac{8}{10}$ feet per mile; this is the maximum grade and there is only one place where it occurs] "following a succession of valleys through the intervening foot-hills. These valleys are generally narrow, having very abrupt slopes on their sides. Fortunately, the line can be kept near the bottom of the valleys, avoiding any difficult or questionable class of construction. The heaviest excavations will be in cutting through spurs of the hill sides, or through divides between adjacent valleys. Across the Pacific plains the line can be given almost any desired direction, the surface being remarkably even and uniform in character." * * * "Many varieties of valuable timber are found, very durable in character, and suitable for either permanent or temporary work in construction, throughout the entire line, with the exception of about twenty miles at each end of it.

"Good building stone is found near the line at short intervals after leaving the valley of the Coatzacoalcos river. Granite, limestone, sandstone and quartzite are among the varieties of stone available for purposes of construction.

"The principal rock cuttings to be encountered near the summit will be in a clay slate formation, limestone appearing at a lower elevation, and granite in the higher ranges on each side of the line." * * * "A careful instrumental survey of the bar at the mouth of the river shows that there is at ordinary tide, fifteen feet of water over it. Surveys and soundings made during the last thirty years give conclusive evidence that this bar has changed very little during that time. Borings to the depth of twenty-six feet encountered no other material than sand and clay, much the larger portion being sand; a stratum of clay was found at the bottom of the borings. This bar has a striking resemblance to the bar at the mouth of the South Pass of the Mississippi river, except that it has less than one-fourth the distance across it, from twenty-six feet depth of water on the inside to the same depth on the outside, and it can be deepened by the same methods that gave such remarkable results at the mouth of the Mississippi river."

The statements made quite frequently by Admiral Ammen that no actual location and profile have been made evidently need no further discussion, nor do any of the arguments, drawn from these misstatements, require further notice.

REVIEW OF SOME OF ADMIRAL AMMEN'S STATEMENTS ABOUT THE
BILL NOW BEFORE CONGRESS.

In criticising the Ship Railway Bill, Admiral Ammen says :
“ There is, however, no mention in the bill of the maximum toll rate upon which vessels would be transported, it might be fixed at \$4 and \$8 per ton.” . . . “ Neither Mr. Corthell in his ‘ Scientific Solution,’ nor Captain Eads in his bill gives the intended rate of toll over his proposed Ship Railway.”

An examination of the bill shows that authority is given to the directors representing the United States and Mexican Governments to reduce the tolls whenever the net income is greater than ten per cent. on the capital of the Company, which is limited in the bill to \$100,000,000. If Admiral Ammen and his co-projectors of the Nicaragua Canal are correct in the estimates they have made of the tonnage likely to use an Isthmian transit-way, it is apparent that, under the provisions of the bill referred to, no unreasonable tolls could be exacted from commerce. But, aside from this, it is absurd to suppose that the Company would, even if it had the power, impose such tolls as would drive commerce away from it. Certainly ten per cent. interest on the amount invested is not an unreasonable return to the capitalists whose money goes to construct the work.

Speaking of the test load of 3,000 tons, (increased by consent to 6,000, and the second year to 7,000 tons,) the Admiral says: “ His vessel may be constructed to weigh 2,900 tons, built expressly to make a land journey, with a cargo of 100 tons!” The transportation of a vessel with

only 100 tons of cargo would not be considered by the Board of Engineers, under whose inspection the test must be made, as answering the requirements of the law. The purpose of the law is to demonstrate the practicability of the work, and no one, unless his antagonism to the project has entirely perverted his judgment, would suppose that the transportation of a vessel, especially built for the purpose and of much greater strength than ordinary vessels, with a few bags of grain, or a few tons of iron as a cargo, would authorize or receive the favorable certificate of the engineers upon which is made to depend the Government guaranty.

In speaking of that clause in the bill which relates to filing a certified copy of the Mexican Concession with the Secretary of State of the United States, within three months after the date of the passage of the act, Admiral Ammen says: "The bill recites that a favorable concession exists, the terms of which are to remain unknown to our legislators." This is another grossly inaccurate statement. A certified copy of the Mexican Concession has been in the hands of the Commerce Committee of the House during all its discussions, and it and all papers relating to it have been at their disposal. The minority report of the Committee gives the Concession in full.

WAR VESSELS.

On page 5, Admiral Ammen makes the statement that a war vessel would not float after being transported over the Isthmus on the railway. This statement is in conflict with the opinion of a host of the most prominent naval constructors and shipbuilders of the world, and as Admiral Ammen could no doubt command a ship much better than he could build one, and as he stands almost alone in his opinion on the subject, his views are not likely to have very

much force. Among the many who differ with Admiral Ammen on the subject may be included the names of Commodore Theo. D. Wilson, the present Chief Constructor of the U. S. Navy; Commodore J. W. Easby, late Chief Constructor U. S. Navy; Mr. Nathaniel Barnaby, Chief Constructor British Navy; Sir Edward J. Reed, late Chief Constructor British Navy. These gentlemen have given the most decided opinions in favor of the entire practicability of transporting laden vessels on a railway.

THE HARBORS.

Admiral Ammen refers to the "factitious presentation of science in the 'Scientific Solution,'" and proffers some information in regard to the harbors which is entirely erroneous. He says: "The 'Scientific Solution' assumes that good harbors either exist, or making and maintaining them is a bagatelle, and the Eads' bill presupposes the fact that a good harbor on both coasts is known to all men; has the great engineer lost his faith in his knowledge of the Jetty system, or has he so solved it that it gives him no concern?" The facts in regard to the harbors are fully given in a paper published by the writer about the first of January, 1886, entitled, "The Atlantic and Pacific Ship Railway." Careful surveys, plans, and estimates have been made of these harbors, and their exceptional advantages for both maritime and strategic purposes have been fully stated in several publications. The writer, having spent a month surveying the bar at the mouth of the Coatzacoalcos river, and having had some little experience in river and harbor hydraulics, is perfectly confident that the plans for deepening this bar from 15 feet, (*not* 13 feet,) now existing, to 30 feet can be done at the estimated expense, which is not great. The "harbor" subject is a very tender one with Admiral Am-

men, because of the total want of harbors at the termini of the proposed Nicaragua Canal. What was once a harbor at Greytown is now wholly destroyed. The San Juan river, to the current of which was due whatever depth of water ever existed at Greytown, long ago deserted its old bed, and now discharges its waters, through the Rio Colorado, in Costa Rican territory. There is a careful avoidance by Admiral Ammen and his friends of all discussions of Nicaraguan harbors.

EARTHQUAKES.

Those informed on the Isthmian question will be surprised at the Admiral bringing forward the danger from earthquakes to the Ship Railway; it being well known that the greatest prevalence and most marked results of earthquakes are *along the line of the Nicaragua Canal*. The actual perversion of facts, by quoting only a part of a statement made by Rear-Admiral Shufeldt, on page 106 of the latter's report, is especially marked. The following, on the *same page*, but omitted by the Admiral, will show how he has perverted what Shufeldt said on this subject:

“The singular freedom of this region from volcanoes, both active and extinct, and, in consequence, the less probability of violent earthquakes, is certainly an important consideration in favor of the Isthmus of Tehuantepec.”

The Admiral brings up another objection, which was brought forward by him three years ago and then refuted, as to the prevalence of high winds on the Tehuantepec Isthmus. He says:

“Were it to be conceded that earthquakes were exceptional, or that were they to occur they would do no more harm to the vessel than would be done ‘to the load of hay passing over a stony road,’ another difficulty presents itself in the ‘northers,’ of which Shufeldt makes mention on page 107:

“‘The northers that are so common in the winter season, never bring with them rain as they generally do on the Atlantic slope and on the table-

lands, but instead clouds of dust and drifting sand are caught up by these violent winds, and are driven across the plain in a southerly direction, and finally fall in the Pacific Ocean.' ”

The following paragraph from the report of Mr. Van Brocklin, who, as before stated, has spent several years on the Isthmus, is sufficient proof of the absence of destructive tornadoes :

“ By reason of the peculiar topographical formation of the Isthmus, there is an almost constant interchange of air currents between the two oceans. The direction of such winds as are prevalent, coincides very nearly with the line of the railway. The very frail construction of the principal portion of the houses on the Isthmus, covered as they are with large and high palm roofs, extending beyond, and generally separated from their walls, the exposed places in which many of them stand, and the absence of any evidence of injury to them, induces the belief that very strong winds are unknown on the Isthmus.”

(See also the recent letter of Mr. Van Brocklin, page 31, and that of Mr. Thayer, page 33.)

This statement agrees with the observation of the writer, and of other engineers who have remained there any length of time.

EXCESSIVE RAINFALL.

On page 8, the Admiral speaks of the excessive rainfall on the Isthmus of Tehuantepec, saying : “ I may add of rainfalls of 23 inches in as many hours.” If he intends by these words to convey the impression that 23 inches of rain falls in 23 consecutive hours, the statement is a misrepresentation as regards any part of Mexico, and shows the Admiral's ignorance of the conditions existing at Tehuantepec. The actual gauging of the rainfall shows the total for one year to be about 100 inches near Minatitlan, the Gulf terminus of the railway. The record at Nicaragua shows an annual downpour of 102 inches, with nearly 6 inches in one day. The railway has the advantage of being built *above the floods*, while the canal must be *underneath them*.

PRACTICABILITY OF THE SHIP RAILWAY.

In reference to the practicability of constructing and hauling ships over a railway, a question which seems to be unsolved in the mind of the Admiral, it is proper to say that as the Ship Railway Company agrees to construct its railway and put it into successful operation before the guaranty asked for attaches, the question as to whether it is practicable to build and operate it is one of little importance to the Government. The report of the House Committee on Commerce contains the following :

“ It is apparent that under the terms of the guarantee the question as to whether a ship railway is practicable is one with which the United States Government has very little concern. If any part of the guarantee was to take effect before final completion of the work, the question of the practicability of the project would be a vital one; but inasmuch as the capitalists who advance the money to construct the road assume all of the engineering risks involved in its construction, and inasmuch as it must be practically demonstrated to be a success before the Government becomes liable to pay anything, the question of practicability is one to the consideration of which it is really unnecessary for Congress to devote itself. In this connection, however, it is but proper to say that in the opinion of the most able and well-known engineers, naval architects, and shipbuilders of the world the construction of a ship railway at Tehuantepec, in accordance with the plans which have been submitted to them by Mr. Eads, is entirely practicable. Indeed, many of these experts go much further than this, and declare that a railway is *preferable* to a canal, first, in the economy with which it can be constructed; second, in the facility with which it may be enlarged when commerce demands its enlargement; third, in the economy with which it can be operated, and, fourth, in its ability to transport vessels with greater rapidity and less delay.”

ENGINEERS AND NAVAL OFFICERS WHO BELIEVE THE SHIP RAILWAY PRACTICABLE.

On page 9, the Admiral says: “Of the many recommendations of the railway in the ‘Scientific Solution’ there is not one of a railroad engineer.” The following are the names of

a few American civil engineers and railroad managers of the highest standing, who have carefully examined the subject and have pronounced the ship railway entirely practicable: Genl. William Sooy Smith, Henry Flad, H. D. Whitcomb, C. Shaler Smith, T. C. Clarke, O. Chanute, late chief engineer of the Erie Railway; Richard P. Morgan, Jr., a railroad expert of Illinois, and formerly one of the State Railway Commissioners; Clemens Herschel, of Boston; Charles Paine, past president of the Am. Soc. Civil Engineers; Col. H. F. Douglass, chief engineer Baltimore & Ohio R.R. Extension to New York; Jas. B. Francis, of Lowell, Mass., past president of the Am. Soc. Civil Engineers; Thos. C. Keefer, C. M. G., member Inst. C. E., London, Vice-Prest. Am. Soc. C. E.; Robt. H. Thurston, G. Bouscaren, E. T. Jeffery, general manager Illinois Central R.R., and to these we could add twenty or thirty more who have also expressed by letter their unqualified faith in its success.

But not alone among engineers is found numberless believers in the practicability of the Ship Railway. The Admiral will find scores of them in the Navy. The writer refers to a few of them, in addition to the two already mentioned, who have expressed themselves as confident that war or merchant vessels may be transported over land with safety on a properly constructed railway: The late Captain Edward Hartt, U. S. Naval Constructor; Mr. F. L. Fernald, U. S. Naval Constructor; Commander N. H. Farquhar; Rear-Admiral R. W. Shufeldt, U. S. N.; Rear Admiral S. P. Carter, U. S. N., and many younger officers of the Navy.

MANCHESTER SHIP CANAL.

On page 11 occurs the following sentence: "Despite of this assertion, the argument of our great Eads abroad that a canal was impracticable, and the obstruction for years by the

railway interests of Great Britain, the Manchester Ship Canal is now in progress of construction." In this sentence are two misstatements. First, Mr. Eads *did not* argue that the Manchester Ship Canal was impracticable; and, second, it is not as yet under construction. Mr. Eads appeared before the Committees of Parliament and proved that if the lower ten miles of the canal was located as proposed in the middle of the estuary of the Mersey, the works would rapidly reduce the tidal capacity of the estuary and ruin the Liverpool docks, and destroy that port. The Committee, after hearing Mr. Eads, rejected the bill unanimously, although it had been reported upon favorably by two previous Committees.

During the hearing, Mr. Eads suggested, in answer to a question of the Queen's Counsel for Manchester, that these ruinous results would not occur if these ten miles were located along either margin of the estuary. The plan was thus modified, and the bill for its construction has since been approved by Parliament.

NO CANAL AT TEHUANTEPEC.

On the same page occurs the following :

" Section 2 of the Eads Ship Railway bill actually proposes the right to substitute canalization over any sections of his route deemed desirable by him, without requiring any stated rate of speed, or stating what the depth and prism of his canal would be! This effectually disposes of the pretension of speed across the Isthmus of Tehuantepec."....." But this proposed canal system of Captain Eads establishes the fact that he is aware that on these marshy and unsolid grounds a solid foundation for a Ship Railway could not be made save at an enormous cost, and then with very uncertain result, whilst the cost of excavating a canal prism would not be great, and would involve no doubtful result, except as to water supply and the establishment of necessary surface drainage."

This statement is doubtless due to a want of knowledge of the facts upon the part of the Admiral. In the concession this means a *channel*, and not a canal, between the Laguna

Superior and the Pacific. As a canal will cost about six times as much per mile as a railway, it would only be resorted to where the railway cannot be constructed. As the Lagoon on the Pacific side will be one of the termini of the railway, some work will have to be done in the nature of canalization to deepen and improve it, and this is the only work of the kind proposed.

In 1881, before any surveys had been made by us except to examine the passes through the central division, it was contemplated to locate the northern terminus on the Uspanapa, a large tributary on the right bank of the Coatzacoalcos; and fearing that within a few miles of the former the ground would prove marshy, a provision was put into the ship railway bill, then pending, providing for a canal through such portion as might prove unsuited for a railway. Further examinations led to the abandonment of that route and to the location of the line *on the other side of the Coatzacoalcos river*. From the northern terminus at Minatitlan to the Lagoon, 134 miles distant, not a single foot of marshy or even doubtful ground is encountered, and no canal whatever is needed.

SUEZ CANAL.

On page 12 the Admiral charges the writer with making, without any excuse, unreliable statements in regard to the rate of travel in the Suez Canal. What the writer stated was this :

“ In the Welland Ship Canal the speed is *one* mile per hour, and the same on the North Holland Ship Canal to the port of Amsterdam. (Internal Commerce U. S., 1885, p. 494.)

“ In the Suez Canal—the most important ship canal in the world—the time required to pass through, one hundred miles, was *fifty* hours, in 1884, or at a rate of *two* miles per hour. The average time of an undisturbed passage, in 1884, was 38½ hours. About 25 per cent. of the distance is through, deep lakes, and 40 per cent. through shallow lakes, only 35 per cent. being through dry excavations. The speed by regulation

is limited to five knots, but this is a dangerous one for steamers, for they are liable to run aground. From 1870 to 1883, *eleven* per cent. of all vessels went aground.

“It was stated in evidence before the Canal Committee of Parliament that in 1882, the passage of ten ships through the canal would choke it.”

The time of passage referred to is the *total time* required to pass through the canal, including the frequent groundings and delays by darkness and by waiting for other vessels to pass. The writer refers for confirmation of his statement to the “Maritime Canal of Suez,” by Professor J. E. Nourse, U. S. N.; to a paper recently read before the Austrian Society of Engineers and Architects, in which it is stated that “the time of an *undisturbed* passage in 1884 was 38½ hours, while the total average, since opening the canal, is 41 *hours 22 minutes*.” In that paper it is further stated: “The long time in passing the canal is a serious objection. The maximum speed allowed is five knots per hour. This and the time lost in the turn-outs makes the trip a long one.” Reference is also made to the testimony of Mr. F. R. Conder, (who is a canal advocate,) taken before the Parliamentary Committee, June 21, 1883, page 127 of the report. Reference is also made to Vol. lxvi, p. 194, Proceedings of the Institution of the Civil Engineers of Great Britain, where Sir Charles A. Hartley says that the greatest speed through the lakes, where there is open and deep water, is, however, reduced to such an extent in the canal proper as to make the average through the entire canal less than five miles an hour, in which statement he refers to *effective* steaming, that is, the speed when the steamer is actually in motion.

NICARAGUA CANAL.

On page 13 of his pamphlet the Admiral quotes the writer as saying of the Nicaragua Canal :

“The most complete and careful estimate of the cost of this work, made by Major McFarland, United States Engineer, is \$140,000,000, with labor assumed at \$1.00 per day.”

The Admiral adds :

“ Mr. Corthell knows even better than the public that Major McFarland’s ‘estimate,’ if it may be called by that title, was not on the line of the present location, so far as canalization is concerned, except from Brito to the junction of the Rio del Medio routes, a distance of eight miles, and that the actual line of canal excavation between the seas is now forty miles, in lieu of the sixty-one miles then given on instrumental surveys. He gives the distance from sea to sea at 186 miles, when it is 170, and the number of locks from 14 to 20, when there are but 7. Is Mr. Corthell really anxious to enlighten the public, or to abuse its confidence ? I am quite aware that he may plead ignorance ; with what justice is known to him and others far better than to the public.”

The above is wholly unjust. The survey of Mr. Menocal, establishing the length of the canal at 170 miles, and 7 as the number of the locks, making also other very important modifications in the location and plans on which Major McFarland made his estimates and which were before Congress last winter, was not given to the public until *November 26, 1885*, and then only in an article without signature in the *American Engineer*, of Chicago. The writer is charged with wilfully holding back information about these surveys and plans in an address delivered and printed *August 26, 1885, three months before*.

As to the abuse of the public confidence, what should be said of Admiral Ammen for bringing forward a profile of the Tehuantepec Route made from a survey of 35 years ago, and putting it before the public as the route of the Ship Railway, omitting entirely to mention an exhaustive survey made for this railway *two* years ago and published for the benefit of the public ?

The unfamiliarity of the Admiral with the plans of the Nicaragua Canal is seen in his statement, on page 14 of his pamphlet, that the locks are designed to lift ships of 30 *feet draught* from the Pacific to the lake level, although Mr. Menocal’s table of depths shows that *nearly six miles* of the canal on this section is to have only 28 *feet depth*, and that *over 40 miles* of the Atlantic division is to have also only 28

feet depth, and that the locks themselves are to have only 29 *feet depth*.

Again the Admiral says: "Wherever the material to be excavated is not fully known through borings, it is given as rock and estimated for rock." He probably intended to say *absence* of borings, as there is no record of any having been made, and to consider the material as rock is really erring in favor of a low estimate, for the quantity and cost would be immensely greater, if it should prove to be earth in a cut nearly three miles in length, of an average depth of 150 feet. M. de Lesseps would be very glad to find solid rock in his great Culebra cut. The *suppressed* estimate of Major McFarland, made November 18, 1874, and only given to the public by Major McFarland himself, after much provocation, incites the ire of Admiral Ammen, whenever it is mentioned, for the reason probably that it is a *fair* estimate of the difficulties to be encountered, and of the cost of the work. The whole report shows a careful examination of the subject, and no doubt the Major is abundantly able to defend his estimate.

About three years ago Dr. Cardenas, the then president-elect of Nicaragua, requested the writer to submit a proposition for making the surveys and plans for the improvement of the San Juan river and harbor, giving as a reason that the government of Nicaragua had become convinced that nothing could be expected of the company represented by Mr. Menocal. Studies of the harbor of Greytown convinced the writer that it was irretrievably ruined, and that it was a very doubtful, if not impracticable, task to permanently improve it. The writer mentions this simply to show that he has had special as well as general reasons for ascertaining the natural conditions existing at Nicaragua. The knowledge the writer is charged by the Admiral with having, but not using, is no doubt that of the plans from time to time promulgated by Mr. Menocal, who, with some other but higher officials of the United States Government, has devoted much of his

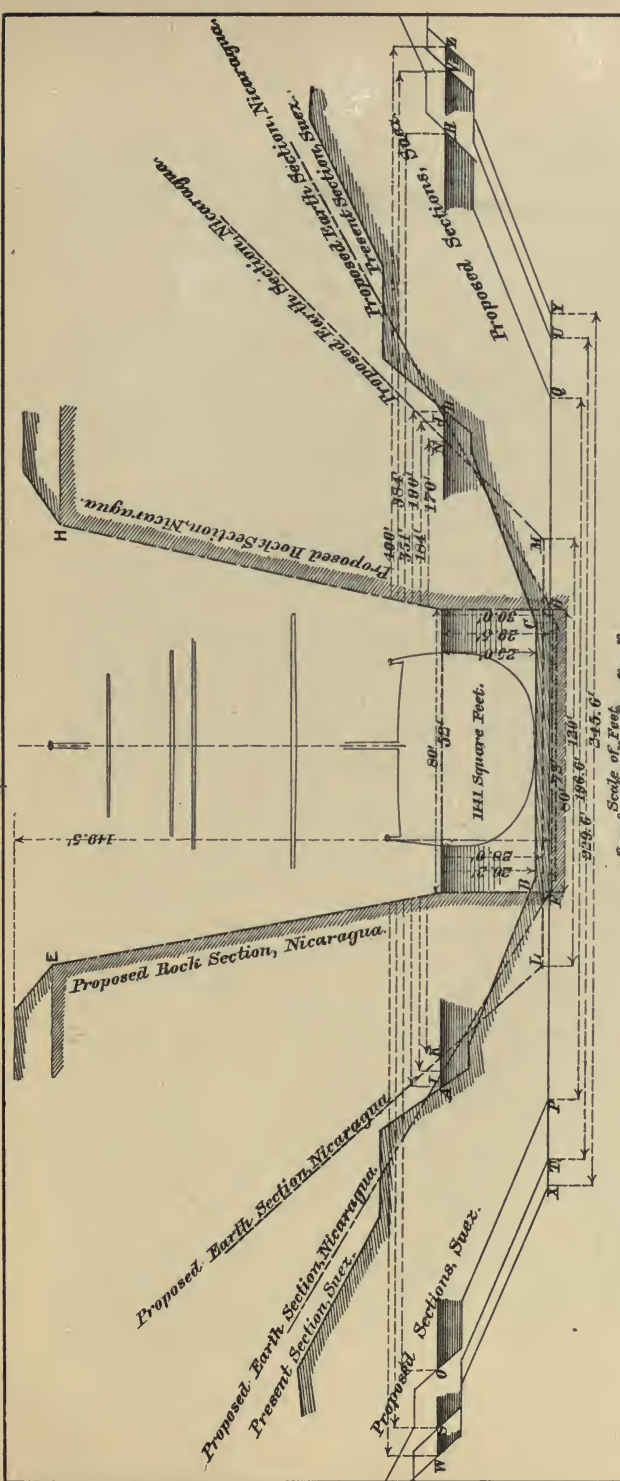
time to this scheme for several years. Their various surveys and plans, however, have not in any way modified the natural conditions existing at the Isthmus of Nicaragua, and Mr. Menocal and Admiral Ammen must not feel hurt if the writer and others use their judgment in selecting the plans and estimates which appear to them to be most reasonable and best considered. It is not to be expected that any one can acquire full knowledge of the various plans, surveys, and estimates which Admiral Ammen is in the habit of making of the Nicaragua Canal route. The plans of Mr. Menocal should not be considered final, if for no other reason than that they are periodically undergoing very important modifications. The examination of the plans which he now brings forward shows how far from a state of perfection, and how poorly adapted they are to accomplish the work for which the former plans were found by Admiral Ammen and Mr. Menocal to be unfitted.

It was recently ascertained that the canal planned in 1872-1873, and essentially the one laid before Congress with the treaty last winter, would not accommodate either the ships or the traffic expected. The new plans now promulgated are intended to correct these important omissions in the earlier plans and to provide, it is said, an adequate channel for ships of 52 feet beam and for a traffic of 12,000,000 tons per annum, and an ultimate traffic of 20,000,000 tons. Though the dimensions are much greater and the prices larger, the detailed *cost of the canal is less*. This happy result has been obtained by a hasty survey made through a densely wooded country, "over ground alternately swampy and hilly, and covered with a dense vegetation, through which every foot of the trail had to be cut with a machette, and where travelling was fatiguing in the extreme, officers and men being compelled in many instances to go long distances buried to the waist in the mud and water, with a very uncertain bottom to stand upon." (See synopsis of Engineer Menocal's report of recent date.)

When this hasty and very preliminary work is compared with the surveys of the Tehuantepec Isthmus for the Ship Railway, occupying nearly *two years*, the greater reliability and accuracy of the latter stand out prominently. It seems proper to the writer to still rely upon the estimate made by Major McFarland for the construction of the Nicaragua Canal, for the reason that it appears to him to be the best considered. Only one exception can be taken to it, in the writer's opinion, and that is in the price of labor, which was estimated at \$1.00 per day. This, by recent developments on the Panama Canal, has been shown to be too low. The writer is informed by Mr. C. Colné, general agent (in this country) of the Panama Canal, that the average cost of labor employed by the Canal Company is \$2.00 per day. As Major McFarland's estimate of the Nicaragua Canal was \$140,000,000, it does not seem unreasonable to place the cost at present at \$200,000,000 if we double the cost of the labor.

INADEQUACY OF THE NICARAGUA CANAL.

Let us see if the Nicaragua Canal as now designed by Mr. Menocal will accommodate a traffic of 12,000,000 tons, which has to pass through rocky excavations and other dangerous navigations, and *not* through a channel excavated in sandy material like that of the Suez Canal. The accompanying sketch shows the cross-sections of the proposed Nicaragua Canal in earth and rock cuttings, the present sections of the Suez Canal, and those recommended for that Canal by the distinguished International Commission of Engineers which recently examined the question of its enlargement. A glance at the ship for which the Nicaragua Canal is intended, and the comparative sections, will show how utterly inadequate is this proposed canal. The impossibility, practically, of pushing a steamer or towing a sailing vessel through the seven miles of rock prism, whose dimensions are *eighty* feet at



SECTIONS OF THE SUEZ AND NICARAGUA CANALS.

DESIGNATION OF SECTION.	SURFACE WIDTH IN FEET.	BOTTOM WIDTH IN FEET.	DEPTH IN FEET.	AREA OF PRISM IN SQUARE FT.	RATIO OF CANAL PRISM TO SHIP SECTION.
ARCD—Suez—Present—Rectilinear	190	72.0	96.2	9577.5	8.136
OPQR " " Enlargement " "	351	136.6	29.5	8069.6	7.090
STUV " " Curves over 5200' Radius	384	225.6	29.5	9063.1	7.943
WXYZ " " " under " "	400	245.6	29.5	9535.1	8.357
FGH—Nicaragua—Rock cut	80	80.0	30.0	2400.0	2.103
IJK " " " Earth	184	120.0	30.0	3960.0	3.471
KLMN " " " "	174	120.0	25.0	4116.0	3.607

bottom, and *eighty feet at the surface of the water, about the width of the Erie Canal*, is very plainly seen and appreciated. In Mr. Scott Russell's Naval Architecture, chapters xxxi and xxxii, appears the following, relating to vessels moving through canals :

“The water excavated from the way of the ship causes a continual accumulation of water in the region of the canal towards which the ship is moving.”.....“If this wave travel ahead of the ship only one-fourth of the pace of the ship, the accumulation will be quadrupled; one-eighth will make it eightfold, and so on, until the progress of the ship becomes extremely difficult, or impossible. This is what constantly takes place as the rise of the ship, and the pace in a narrow and shallow channel becomes greater. Practically, working at high speed becomes not difficult or costly, but impracticable.”.....“The consequences of this rapid increase of head accumulation, which takes place as the speed of the wave in advance of the vessel diminishes, are very serious. First, it throws the ship's head up out of trim; next, it increases the pressure of water on her bow; third, it makes her travel up-hill; fourth, it produces a backward current along her sides. And these hindrances to speed accumulate rapidly, much more rapidly than as the square of the resistance, until the amount becomes insuperable; that is, many times the resistance due to the law of the square of the speed.”.....“It is now necessary to notice the complementary effect to that of accumulation in advance of the vessel; it is subsidence of water astern. It being known that the excavated water is sent on in advance of the vessel, it becomes plain that the channel out of which this water has been taken must have its height lowered by the subsidence of the water into the vacant channel out of which the ship has been drawn.”

With these principles before us, and in view of the fact that this narrow prism of the canal covers a length of *seven miles*, the reader can form an accurate idea as to whether the ship will pass *safely* through the designed section in rock excavation at *any* speed, much less the speed of *five miles an hour*, as estimated by Mr. Menocal. Attention is also called to the ratio of the immersed section of the vessel to the water prism of the canal as shown in the table on the diagram of sections.

It is stated in Engineer Menocal's report that steamers can make eight miles an hour in the San Juan river. The width at the bottom in the first 28 miles from the lake is to be

only 125 feet in many places, and the channel is often very tortuous. On the western division the same difficulty exists in certain parts of the crooked and narrow valley of the Rio Grande. A rate of speed over three or four miles an hour in these tortuous and restricted river channels would be a dangerous one. It is extremely doubtful if the large sailing ships which now go around Cape Horn could be towed *through the canal at all*. It would be necessary for the tow boats to take them astern, which would make it extremely difficult to steer them through the restricted portions of the canal.

ESTIMATES OF THE CANAL NOT SUFFICIENT.

In reference to the cost of construction there is much to criticise. The upper reach of the San Juan river for twenty-four miles is to be dredged a mean depth of four feet. The plan of 1873 required the removal of 834,832 cubic yards of rock under water. Mr. Menocal estimates that the present plan requires the removal of only 398,613 cubic yards. Every constructive engineer of experience will testify that from twenty to forty per cent. more rock is usually excavated than is included in the neat section of the work when it is removed from below water. It will be fair to assume that, to remove this 398,613 cubic yards of rock under water, will require the removal of at least 500,000 yards. The price estimated is \$5 per cubic yard. In the opinion of the writer this is too low. It has cost to remove submarine rock in New York harbor, where every facility is at hand, and all conditions are favorable, from \$16.30 per cubic yard to \$34.00. (See detailed report of Gen. Roy Stone, in the report of the Chief of Engineers on the Hell Gate Improvements.) On the Welland Canal the tenders for the removal of from 15,000 to 20,000 cubic yards of rock under water ranged from \$9.90 to \$40.00 per cubic yard. The work was done at the former figures, but the

quantity removed to give a clear channel depth and width was 34,600 *cubic yards*. (See *Engineering News*, July 11, 1885, page 17.) Under the circumstances existing at the San Juan river, with labor much more expensive and less effective, with appliances difficult to obtain, and with work scattered over twenty-four miles, \$15.00 per cubic yard is not too large a price for an estimate. The addition required to the estimate from this cause alone will therefore be \$5,506,935.

The harbor at Greytown, heretofore referred to, is so fully discussed in Major McFarland's report that it is unnecessary to allude to it further, except to state that corroborative testimony is found in a paper by Professor Henry Mitchell on "The Terminal Points of the Nicaragua Canal," in the United States Coast Survey Report of 1874, and also in the report of the Committee of the National Academy of Sciences, 1866. Major McFarland's estimate for its improvement was \$9,500,000. The estimate in 1873 was \$2,822,630. Mr. Menocal's estimate *now* is \$1,766,625, a difference of \$7,733,375 between that of Major McFarland and that of Mr. Menocal.

The question of successfully improving the harbor at Greytown is one of vital importance to the canal. The problem to be solved is how to restore and maintain a harbor that has been completely ruined and practically obliterated by forces it is well nigh beyond the power of man to control. Natural causes have diverted from their former channel the waters of the lower San Juan, and turned them into the Colorado river, which debouches into the sea through Costa Rica. When it is borne in mind that our engineers have failed to deepen the channel into a single harbor along the whole sweep of our Atlantic and Gulf coasts, except the mouth of the Mississippi, the folly is apparent of intrusting to an amateur the design and estimates for a work as difficult as that at Greytown.

Not only in this country, but also in Europe, has the improvement of harbors taxed the skill of the ablest hydraulic

engineers for years, and immense sums have been expended by them in improving or constructing harbors under conditions much less complicated than those at Greytown. One of the most difficult problems ever presented in hydraulic engineering is the construction of a deep and safe harbor on a sandy beach exposed, like that at Greytown, to the severest storms of the sea. Yet a young engineer, of very limited experience, has been intrusted with this grave problem, and the result of his hasty studies and his periodical plans and estimates for this immense canal and its harbors occupied for months the serious attention of statesmen, committees, and senates.

There are several questionable and entirely novel methods proposed for the Nicaragua Canal which need examination by *experienced* engineers before they are pronounced practicable. As an instance may be mentioned a lock with 53 feet lift by the ordinary process. 30 feet is the greatest lift on any constructed canal, and that on the small Lehigh Canal. The tail-gate of the lock of 53-feet lift, 88 feet in height, is said to be of "novel design." We should think so!

The impounded waters of the San Francisco river are to be held back by a dam over 6,000 feet long and 51 feet in height.

The most radical and objectionable feature of the canal plans is, however, the general disturbance of the regimen of the rivers and the drainage of both slopes. Rivers are taken out of their natural beds, from the valleys in which they have run for all time, and are turned into artificial channels and in entirely new directions. The Rio Grande on the Pacific side, a mountain stream, and at times a torrent, is diverted from the Pacific towards the Atlantic, that is, into Lake Nicaragua.

The following from the official synopsis of Mr. Menocal's recent report is an illustration of the apparent ease, with which the new regimen, in another instance, is to be established:

“ At this point the Deseado will be diverted by a channel north of the canal a distance of 43,000 ft. (8 miles;) the latter will be protected on both sides by drainage channels formed partly by the present bed of the stream and partly by ditches. The remainder of the canal, also about 43,000 ft., from the Deseado to the sea, will be protected by embankments, an artificial channel being cut south of the canal to divert the river San Juanillo, and another north of the canal to give Laguna Bernard and its tributaries an independent outlet to the sea.”

Other river beds are to be dried up to give room for the canal, and their torrents are to be turned in any direction, and by any means, necessary to give the canal free “right of way.” These streams are to be carried long distances apart from the canal, either inside embankments or in channels excavated in earth or rock. The general contour lines of the country do not impede the plan at all, and it may be said that the whole drainage system of the Isthmus is entirely and most conveniently rearranged. Three months’ time was sufficient to make surveys that entirely modify all previous plans, and practically remodel the Isthmus, although it required with other extraordinary changes, deep rock excavations, one of which for about *three miles* in length, has an average depth of $149\frac{1}{2}$ ft., and a maximum depth of 204 ft., and another a maximum depth of 318 ft., almost rivalling the famous Culebra cut of the Panama Canal.

One important object of Mr. Menocal’s recent survey, as has been stated, was to find a location and natural conditions that would permit enlargement of the previous dimensions, so as to transport, *unimpeded, a traffic of 12,000,000 tons*, for “the Suez Canal is *unable to accommodate a traffic of more than 6,000,000 tons per year, without serious delays to navigation, owing to its dimensions* and insufficient number of turn-outs.” (American Engineer, November 26, 1885, presumably written by Mr. Menocal.) Practically the same is stated in the official synopsis of his recent report to Congress: “The apparent insufficiency of the Suez Canal to accommodate a traffic of more than 6,000,000 tons a year, without serious delay to navigation due to its reduced sectional area and the

inadequate number of its turnouts, shows that the dimensions proposed in the previous reports for a canal across Nicaragua should be considerably enlarged." The above statement is correct, as far as the Suez Canal is concerned, and it was to remedy this very serious evil that the International Commission was called together. They decided that certain dimensions were necessary to accommodate the present traffic. The Nicaragua Canal dimensions are intended to accommodate a traffic *twice as great*, and the impression is conveyed in the official report that the plans *have been made with this special object in view*. "The constant object has been to provide for a canal which should permit the passage of the largest ships now engaged in the commerce of the world, and a traffic of no less than 12,000,000 tons per year, without restriction, rather than, for the sake of economy in first cost, propose what experience at Suez has proved to be inadequate." (See American Engineer, Nov. 26, 1885, page 227.) The cross-sections (see sketch, page 19) show that, in a distance of 37.6 miles of excavated canal, (the total length being 38.98 miles,) the dimensions now proposed by Mr. Menocal *must be enlarged one hundred and fifty per cent.* to make them as large as those decided upon for the Suez Canal to accommodate a traffic *fifty per cent. less* than that assumed to have been provided for by the Nicaragua Canal plans. The average of three sections proposed for the *Nicaragua* Canal gives an area of 3,492 square feet. The paper read before the Austrian Society gives the section of the Suez Canal as 3,956 square feet. The average of the proposed enlargements of the Suez Canal is 8,576.3 square feet. (For details, see the table on sketch, page 19.) As this 37.6 miles of the Nicaragua Canal comprises the most expensive part of the work, it seems fair to increase the cost proportionately if we are to modify the estimate to produce an *adequate* section. The estimated cost of this part of the work as at present designed is \$28,546,542. The cost of the same on the basis of the Suez Canal enlarged section is \$42,819,782, at Mr. Menocal's prices. If the chan-

nel in the San Juan river and the nine miles of excavated channel in Lake Nicaragua are enlarged from 125 feet bottom width in the first case, and 150 feet in the second, to that of the Suez Canal enlargement, which is 224 feet, the increased cost in the first case will be \$3,530,453, and in the second case, \$189,760. To make a harbor at Brito will cost, as estimated by Major McFarland, \$5,000,000. Mr. Menocal's estimate is \$1,611,500, or \$3,388,500 *less*. As all who have examined it call it a "harbor only by courtesy," and as no essential change has occurred there in the last twelve years, to the writer's knowledge, it is judicious to assume that Major McFarland's estimate is quite as reliable as that of Mr. Menocal. Summing up the several additions to the estimate, and adding 25 per cent. for contingencies—which has been added by Mr. Menocal to his estimate—we have a total *increase* of \$88,960,898. The total estimate as given by Mr. Menocal is \$64,043,699. The total revised estimate is therefore \$153,004,597.

The very expensive work, as it certainly will be found to be, of modifying the whole drainage system of the Isthmus, and providing adequate channels to carry to the sea the floods of an annual rainfall of 102 inches without danger to the canal, have not been touched upon in this review, for the reason that the topography of the country and the detailed plans and estimates are not available. It should also be noticed that Major McFarland's estimate was based on a canal whose average sectional area was 2,309 square feet only, while Mr. Menocal's area is 3,409.2 square feet, about *fifty per cent.* greater than Major McFarland's. If we assume that it would require an addition of 40 per cent. to build the canal *according to Mr. Menocal's sections*, the total cost, then, on Major McFarland's basis would be \$189,500,000, and, to build it according to the Suez Canal enlarged dimensions \$264,500,000.

Mr. Menocal, who was hastily despatched to the Isthmus last winter without authority from or appropriation by Congress, had a serious work to accomplish in a very inadequate

time. It was actually necessary to design a *larger* canal and find a location for it so favorable that the cost would not exceed the estimate of the canal whose plans were then before the Senate. How fully he accomplished *this* part of his task is seen by placing the two estimates side by side: The estimate before the Senate was \$65,722,147; the present estimate is \$64,043,699, or \$1,678,448 *less*, while the canal is *fifty per cent. larger*. Whether the plans and estimates can be made satisfactory to intelligent men is exceedingly doubtful. It cannot be successfully denied that the section now designed *does not give the free and unrestricted waterway* that is *absolutely necessary* to make it favorably compare with a ship railway as a means of transportation, and that it does not *at all compare* with the adopted dimensions of the Suez Canal enlargement, and does not in *any sense* overcome the *very serious embarrassments* under which the Suez Canal labors at present.

PERSONAL ASSAULT UPON MR. EADS.

In an address before the American Association for the Advancement of Science, the writer took occasion to refer to the great works accomplished by Mr. Eads, and to speak of his acknowledged ability as an engineer.

This passage has greatly disturbed Admiral Ammen, and he occupies *six* pages of his pamphlet in personal abuse of Mr. Eads and detractions of the various important works that he has accomplished. According to the Admiral all of these works are failures. The 14 ironclads which he designed and built with such marvellous celerity were but poor affairs and rendered no real service; the bridge across the Mississippi at St. Louis, pronounced by the British Encyclopædia to be the finest specimen of arch construction in the world, is a flimsy structure, likely at any moment to fall into the stream; and the jetties at the mouth of the Mississippi

river will soon be choked up with sand. The motives which prompt this personal attack upon Mr. Eads are so apparent as to excite for their vindictive author a mingled feeling of pity and regret.

Not only does Admiral Ammen assail the works of Mr. Eads, but he even goes so far as to attack his personal character. That character needs no defence, especially against one who strives to defeat an enterprise of immense public utility, by the personal abuse of its projector, and the revival of stale and refuted slanders against him.

To mislead the public regarding the personal relations existing between General Grant and Mr. Eads, (which up to the day of General Grant's death were of the most friendly character,) Admiral Ammen publishes in his pamphlet an extract of a letter written by the General in 1882, to Mr. Eads, in reference to the Ship Railway Bill then pending in Congress. This letter embodied several of the misrepresentations published at the time by the Admiral and Captain Phelps to defeat that bill, and was written under the evident impression that their interpretation of the bill was correct. Under this view he deemed it proper to write to Mr. Eads that he should oppose the bill, because he had previously given him to understand that he would not do so. At the same time he sent a copy of this letter to Senator Miller, of California, who had charge of the Nicaragua Canal bill, and who was a decided advocate of that measure. On receipt of the letter Mr. Eads at once sent a reply by the General's son, Mr. Jesse R. Grant, pointing out to General Grant the misapprehension under which he was laboring. Within two days after the date of this reply, J. R. Grant wrote and telegraphed Mr. Eads that his letter was satisfactory; *that a copy of it was sent to Miller, and that the General had written to him, Miller, explaining the error he had made.* General Grant therefore had sent the copy of Mr. Eads' letter and *his own admission of his error* to Senator Miller *immediately* after receipt of Mr. Eads' letter, for the evident purpose of cor-

recting the wrong impression which his letter to Mr. Eads would naturally produce in the mind of that Senator. General Grant soon after wrote to Mr. Eads *reassuring* him that he would put no obstacle in the way of the passage of the Ship Railway bill. That Admiral Ammen should be supplied with a copy of General Grant's letter to Mr. Eads, by either Grant or Miller, without learning from one or the other anything about Mr. Eads' reply to General Grant or the copy of it sent to Miller and his subsequent and immediate admission to Miller by letter that he was in error, is simply incredible. It follows therefore that Admiral Ammen has been making a most discreditable use of General Grant's letter, and one that must be condemned by every fair minded man who will read that letter and Mr. Eads' reply. Both of these will be found in the appendix to this review with collateral facts relating to this part of Ammen's personal assault upon Mr. Eads. His suppression of these facts proves that he is willing to place his deceased friend and benefactor in a false position before the public, to gratify his hate of Mr. Eads for wrecking his pet scheme on which he had doubtless based his hopes of a colossal fortune and an imperishable fame. One of the noblest characteristics of General Grant was his readiness to admit an error at once when convinced that he had made one. A notable instance of this manly virtue is shown by him in this correspondence, and the suppression of all reference to it by Admiral Ammen places the characters of the two men in strong contrast.

As Admiral Ammen has chosen to criticise Mr. Eads' professional abilities and to ridicule and belittle the high expert testimony we have adduced in favor of the Ship Railway, the writer will be pardoned for answering the natural inquiry: "Upon what meat doth this our Cæsar feed, that he is grown so great?" We find that at the age of 41, when the late war broke out, he was a lieutenant in the navy in command of the gunboat Seneca, which he assures us was not fit to be carried across the Isthmus on a carefully prepared

railway. If he ever commanded a fleet for a day, history has failed to record it. Certain it is that his services during the whole war were not sufficiently important to secure his promotion to a captaincy. This tardy recognition of his abilities came in 1866. Tradition has it that he had saved Grant from drowning when they were boys together, and Grant was not made of the stuff to forget such a favor. When he came into power Captain Ammen fared better. He was furnished with a good soft place as Chief of a Bureau in the Department, a comfortable salary, and the usual rations, perquisites, etc., and after decent delay he was made, in 1872, a Commodore, and finally, a Rear-Admiral.

With all due respect to the Admiral the writer fails to see, in the record of this officer, how he has become fitted by education, experience, or any notable success whatever, during his whole official career, (except in the way of promotion,) to make him an authority on hydraulic engineering, in the science of shipbuilding, or in the construction of railroads and lifting docks. With about half of his life spent as a midshipman and lieutenant on shipboard, and the remainder as a fixture in the Navy Department, he essays to ridicule and criticise the projector of the Ship Railway, and the most noted and successful experts in these various departments of civil engineering who gave their hearty endorsement to the Ship Railway.

The Admiral and his coadjutors place much stress on the fact that we have adduced no evidence from underwriters that they will insure a ship in transit on a ship railway. They forget that the railway company will be a *common carrier*, and will therefore be responsible for the safe delivery of every package (that is, each ship) it receives at one end of the line until it is delivered in good condition at the other end. Hence the insurance companies, during this part of the voyage, are relieved of all risk, (except perhaps that of fire,) and a company with a capital as big as twenty or more insurance companies becomes responsible for each vessel after it undertakes to transport it on its railway.

MR. MENOCAL'S WANT OF KNOWLEDGE AS TO TEHUANTEPEC.

The letter of Engineer Menocal incorporated in the pamphlet of Admiral Ammen shows such a lamentable want of knowledge of the Tehuantepec Isthmus and the Ship Railway location and plans, that it is scarcely necessary to weary the reader by the many flat denials needed to correct his misstatements. The most important of them we will, however, take up briefly. The larger part of his letter is based on the assumption, which we have already shown to be false, that there is "nothing but assertions and generalities to deal with" in reference to the natural conditions existing on the Isthmus.

CONTROVERTING STATEMENT OF MR. MARTIN VAN BROCKLIN.

A recent letter of Mr. Van Brocklin, taking issue with Admiral Ammen and Mr. Menocal in reference to the statements made by them, will confirm whatever the writer has said in reference to the favorable conditions existing at Tehuantepec for the construction of a ship railway.

"ONEIDA, N. Y., *Feb'y* 26, 1886.

"E. L. CORTHELL, Esq. :

"DEAR SIR: I have read the pamphlet entitled *The 'Certainty of the Nicaragua Canal, contrasted with the Uncertainties of the Eads Ship Railway,'* by Daniel Ammen.

"The first thing presented is a profile said to be from Barnard's survey. My knowledge of the topographical features of the Isthmus of Tehuantepec, gained in making surveys at intervals from 1859 to 1883, enables me to say that a line *can* be traced across that Isthmus that will give a profile as irregular in surface as the one furnished, and further, that should it suit the purpose of a supposed investigator, a line showing *greater* irregularity of surface can, I think, be obtained. What a profile of the line surveyed by Barnard has to do with the line located for the Ship Railway is inconceivable. It seems incredible that a person of the prominence of Rear-Admiral Ammen would undertake to seriously discuss so important a problem as the practicability of the construction of a railway for the transportation of ships across the Isthmus of Tehuantepec, while so lamentably

ignorant of the physical conditions existing on the line located for it, and of the difficulties to be encountered in its construction, as the pamphlet demonstrates him to be. He should have known that you had a complete detailed survey of the route including surveys for the improvement of the harbor on each side, (see page 18 of the publication of yours he quotes,) and a profile of the line indicated, giving full details of the work to be done, and yet for a purpose best known to himself he presents data obtained from Barnard's survey made in 1851, in another locality, and for an entirely different purpose, and also from a preliminary examination, by Mr. Garay, of a pass through the main divide, 10 miles distant from the line finally selected.

“The ‘forty miles of swamp-land, more or less, from Minatitlan towards the Pacific,’ that forms the basis for his *argument* of the ‘Farmer,’ and the ‘Marine ram,’ is a fiction, so far as its application to the Ship Railway is concerned; it describes no part of the ground upon which that work will be built. At every place on the line of the Railway, from the river bank at Minatitlan to the harbor on the Pacific side, the Railway will rest upon firm, unyielding material, possessing ample resistance to sustain any weight that will be placed upon it. There is an aggregate distance of perhaps eight miles, but dispersed in sections over the first thirty miles from Minatitlan, where the surface is covered with water during freshets in the Coatzacoalcos river, but these places cannot be called ‘swamp-land,’ as the material is a firm tenacious clay, and where not covered by a dense undergrowth, they afford valuable grazing ground for the large herds of cattle found in that locality.

“In the appended letter from Mr. Menocal it is demonstrated, evidently to his own satisfaction, that a vessel 300 feet long, and having a draught of 22 feet, will be exposed to an overturning moment of 4,000 foot tons, from the force of winds alleged to be prevalent at Tarifa during certain seasons. The authority quoted in the pamphlet shows conclusively why such winds as do cross the Isthmus are confined to a given direction; the same reasons give a similar direction to the railway, and just how Mr. Menocal is to apply the force of the wind to the side of the vessel is not apparent. Evidently the people living at Tarifa are unmindful of the dangers to which they are exposed, as shown by Mr. Menocal's figures.

“The buildings of the hacienda of Tarifa stand in the open plain, and are exposed to the full strength of such winds as cross the Isthmus at that place. These buildings are covered with palm, and are, most of them, of very frail construction. The roofs are usually much larger than the walls of the house under them, extending far enough to give a broad veranda on each side. The theoretical wind of Menocal would demolish such frail structures. The fact that they stand uninjured, at Tarifa, and at all places on the Isthmus as well, is evidence that the actual force exerted by winds will not be a serious obstacle in the operation of the Ship Railway.

“Very truly,

“M. VAN BROCKLIN.”

The following letter from Mr. Deming J. Thayer, a civil engineer of large experience, furnishes additional confirmation of the thoroughness of the surveys for the Ship Railway and of the favorable conditions existing at the Tehuantepec Isthmus.

“ NEWTON, KANSAS, *March 6, 1886.*

“ E. L. CORTHELL, Esq.,

“ *Chf Engr. Tehuantepec Ship Ry., Washington, D. C.:*

“ DEAR SIR: Rear-Admiral Ammen and Señor Menocal show, in their writings contained in the pamphlet recently published by the former, entitled, “ Certainties of the Nicaragua Canal Contrasted with the Uncertainties of the Eads Ship Railway,” a deplorable ignorance of the work done and results obtained by the engineers in the employ of the Ship Railway Company. The following corrections of some of their errors and information for ‘ seekers after truth,’ I take pleasure in placing in your hands.

“ From March, 1883, to July, 1884, from five to seven engineering parties fully equipped for the work they were to undertake were constantly in the field between Coatzacoalcos and the Pacific Ocean. The first six months in charge of Mr. Martin Van Brocklin, resident engineer, and the latter months under the direct supervision of the writer.

“ We surveyed in an exceptionally thorough manner a continuous line from Minatitlan to the Pacific Ocean at Salina Cruz, that had no *marsh or swamp-land on any part of it, no grade* exceeding 52.8 feet per mile, or a curve of less than twenty miles radius.

“ Later, we made lateral explorations, and exhausted practically the possibilities for improving the line, and obtained, as a result, the present location. Our lines were traced with the greatest care, check levels were run over the entire route, and especial attention was given to the extensive lateral topographical lines locating all streams and ridges of any prominence in the section of the Isthmus where any possibility existed of its being desired to trace a survey later. Maps, profiles, and reports of the work done, duly revised and certified to by the engineers in charge, were sent to you as frequently as possible, and I presume are in your possession at present for the information of ‘ seekers after truth ’ as well as for the needs of the Company.

“ The hydrographic work accomplished was important. The Coatzacoalcos river had its banks carefully located by transit lines from the initial point of the railway line above Minatitlan to the mouth of the river; and a detailed survey was made of the bed of the river. A large force of men was employed several weeks in this work alone.

“ On the Pacific coast, the Upper and Lower Lagoons were thoroughly sounded, not as on previous occasions on given lines and at stated inter-

vals, but extensively, and each sounding located from angles from carefully measured base lines on their shores.

“ Borings were made to ascertain the material forming the bottom of the Lagoon in all important localities. In the Lower Lagoon, in a previously unexplored portion we discovered a basin only separated from the ocean by a sand-spit a couple of miles wide, which was two miles in diameter and had a uniform minimum depth of 22 feet, with a clean sand bottom. This basin is protected on the north by a rugged spur of mountains and is entirely land-locked; it will make, with little relative expense, one of the finest harbors in the world.

“ Maps of all these surveys, as well as of the harbors of Salina Cruz and Bar of Coatzacoalcos are in your possession.

“ In regard to ‘ marshy and swampy ’ ground, which our cited pamphlet lays such stress upon as covering a great portion of our line, let me say that in the lower Coatzacoalcos Valley, near Minatitlan, in the most unfavorable localities we could select, soundings with an apparatus made of gas pipe with a steel point to be driven down with blows showed that there exists everywhere, as a foundation for masonry, near the surface of the ground impenetrable strata of sand, gravel, or hard-pan; there was no exception to this rule; the upper over lying soil was a stiff clayey alluvion entirely suitable for the foundation of embankments.

“ The force and effect of the ‘ northers,’ in my opinion has been greatly exaggerated; they blow steadily, are not shifty, nor do they blow in gusts. There exist in no part of the world more flimsy structures than the country houses on the Isthmus of Tehuantepec, and they are loosely thatched with palm leaf or grass thatch.

“ I have never seen one blown down, or its roof blown off or damaged in any way by a ‘ norther.’ I have stood on a bare mountain summit on the divide near Tarifa and faced the whole force of one of the strongest winds of this kind ever known there. I could not have stood up in it had its force been any where near 40 lbs. to the square foot, (over 90 miles an hour,) as Señor Menocal estimates. It would have blown me to the plains a thousand feet below.

“ Very truly yours,

“ D. J. THAYER.”

Mr. Menocal has given reports from the statements of three prominent engineers, one of them, Mr. Garay, a prominent Mexican engineer—

“ Who located the line for the road across the mountain ridges for a distance of forty miles.” * * * “ The line run by him crosses the range of mountains, the deepest proposed cutting being 312 feet. He adds that in all the line there is no grade greater than two per cent., and for no greater distance than two and a half miles.”

(See page 24 of Admiral Ammen's pamphlet.) The line surveyed by Mr. Garay is *not* the "located" line of the railway. It was a preliminary or trial line, surveyed to ascertain if an economical line with low grades could be obtained through the Chivela Pass. The located line runs through the Tarifa Pass, 10 miles distant. Mr. Menocal states that Mr. Fuertes, who was the engineer on the survey of the Ship Canal route under Admiral Shufeldt, confirms this statement of Mr. Garay by his report on the Ship Canal. The reader will see how entirely unfair is a comparison of a *ship canal* route with a *ship railway* route. Professor Fuertes himself has made a statement in regard to the practicability of building a ship railway across the Isthmus of Tehuantepec, based upon his own observations there, and from this statement the following quotation is made :

"I can assure you, upon knowledge of every inch of the ground, that you will find no difficulty about curves, grades, or bridges. The ascent of the Atlantic slope will offer no more difficulties than the Hudson River R. R.; and, on the Pacific side, either one of the three passes in the neighborhood of Tarifa or Chivela will require no steeper grade than 25 to 35 feet per mile, to bring you down to the Pacific plains."

The above is quoted from testimony given to Congress three years ago, and which Mr. Menocal has knowledge of.

Mr. Menocal refers also to another engineer, Mr. William J. MacAlpine, who says :

"I have described from *personal* surveys the route which his (Eads') engineer has selected, and have spoken of the enormous cost and difficulty of carrying his railway across the deep swamps of one-half, at least, of the first sixty miles from near Minatitlan, of the south descent of the Sierra Madre slope, (500 feet in four miles.)"

Mr. MacAlpine had no knowledge of the line selected. It had not been surveyed at that time. His remarks refer to the line run by Mr. Garay, already alluded to.

Mr. Menocal makes several misstatements in describing the mechanical appliances of the Ship Railway. He states that "the construction and operation of cradles weighing

1,000 tons or more, composed of an infinite number of parts, each of which must be accurately adjusted to sustain its part of the load, with pumps, engines, and rams." Mr. Menocal does not understand at all the plans he is criticising. The cradle will be a remarkably simple structure, composed of duplicated parts, which do not require adjustment, and there are *not to be on, or in, the cradle any pumps, engines, or rams.* They are fixtures in the dock.

INACCURATE STATEMENT OF MENOCAL ABOUT OTHER SHIP CANALS.

Mr. Menocal attempts to prove that the tendency toward larger canals and greater loads exists upon canals as well as upon railways. This no doubt, in a measure, is true, as it is one of the necessities of the times, but enlargements and improvements to meet the requirements of traffic are very difficult and expensive upon canals, and rarely made. He states :

"Are not the Caledonia, the Amsterdam, the Languedoc, the Welland, the St. Mary's Falls, the Suez, and many other canals now in successful operation, and being constantly enlarged and improved to meet the rapidly increasing traffic, and those under construction or about to be constructed at Panama, Manchester, Cape Cod, Corinth, Baltic, &c., improvements on the canals referred to by Mr. Corthell?"

This statement presents a strong array of what the reader would naturally suppose were all large modern ship canals, or being constantly enlarged, and with capacious channels. The facts are these : The natural features of the country along the line of the Caledonia Canal across Scotland are quite similar to those existing at Nicaragua. Its summit is 100 feet above the level of the sea. It is 60 miles long, 38 miles being through lakes. It was built early in this century, before the era of railroads, and has a capacity for vessels of *only 300 tons.* Mr. Vernon-Harcourt, in his book on canals, states : "Regarded merely as an engineering work, the canal was a bold and successful undertaking, very judi-

ciously planned and successfully carried out ; but it has not proved a commercial success."

The Amsterdam Canal, if Mr. Menocal refers to the new canal, is a short deep channel from the Baltic Sea to the Zuider Zee, and has but one lock in its length of $15\frac{1}{2}$ miles, and was excavated through lands reclaimed from the sea. It was an absolute necessity to Amsterdam. The Languedoc is an ordinary Barge Canal, and *not* a Ship Canal, extending from the Bay of Biscay across France to the Mediterranean Sea. It was built in 1667, is 171 miles long, and has a depth of *only 5 feet and 3 inches*. It has not been enlarged, and is of merely local value. The Welland Canal, although intended to be of sufficient depth to accommodate the traffic of the great lakes, and take the grain to Montreal, has been found to be entirely inadequate, as there is a depth of only 14 feet in the locks. This mistake is almost irreparable, and an adequate enlargement cannot be made, except at great expense.

In reference to the Suez, once more, which is by far the most important ship canal in the world, the expense of deepening and widening it for even its present navigation is estimated at 200,000,000 francs, or \$40,000,000, by the distinguished International Commission. This estimate is the same as that given by a former International Commission for the *original construction of this canal*.

The Manchester Ship Canal, although approved by Parliament, has not yet been commenced. The Cape Cod Canal has been in embryo for 219 years, and has been scarcely commenced, work upon it being now suspended. The Corinth Canal is almost over the same ground where the Athenians, 550 years B. C., built the "Dioclus," a *veritable ship railway* of polished granite, which they operated for 300 years. Had the Greek of the present day the skill and energy of the ancient Athenian, his great ancestor, he would have constructed a *new and improved ship railway, instead of digging a ditch*. The Baltic Canal, also alluded to by Mr. Menocal,

has not been decided upon, and recent information shows that it has only just been presented for the consideration of the Reichstag. This short paragraph, therefore, of Mr. Menocal in reference to these important ship canals needs to be supplemented by these facts to show how little weight it possesses.

CAPACITY OF THE SHIP RAILWAY.

The ultimate capacity of the Ship Railway is practically unlimited. It is the intention of its projectors to construct it at the outset for vessels weighing with their cargoes 7,000 tons. There are less than a dozen steamers registered under the American flag that have a greater load displacement than 6,000, and there are no sailing vessels of greater weight. There are no war vessels, either now in the service or contemplated, whose weight with armament, coal, and supplies on board, will exceed 6,000 tons.

The bill now before Congress requires the transportation of vessels, weighing with their cargoes at least 6,000 tons, as a test of its practicability, and 7,000 tons after the first year. This, however, does not represent its full capacity after the roadway has become well compacted and settled. It is also the intention to so prepare the foundations and excavations that the railway may at any time be enlarged to transport still larger vessels, when commerce demands it.

One great advantage of the railway over the canal lies in the fact that it can be easily and inexpensively enlarged for an increasing traffic and tonnage without interruption to its regular business.

The facts stated publicly by the writer during the last two years going to show the marked superiority of railroads over canals, and ship railways over ship canals, have not been refuted. These facts are drawn from the history of transportation in various countries during the last sixty years.

From the discussion of the Nicaragua Canal in the preceding pages it has been seen that the disadvantages of the ordinary barge canal exist in a still greater degree with such a ship canal as has been proposed for Nicaragua. The advantages, however, of the ordinary railway are greatly enhanced in the ship railway. These increased advantages arise from the following conditions: the rails are straight, the track perfect, the grades light, larger loads are carried, the ratio of paying to non-paying loads is greater, the frictional resistance to the motive power is reduced, the speed is slower and less destructive both to the track and the rolling-stock. One of the most important advantages lies in the fact that it will not be necessary to handle the goods. This is one great source of the expense of operating ordinary railways, and it is generally considered that it costs as much to handle a ton of freight as it does to transport it 100 miles. The immense clerical force employed on ordinary railroads will be almost entirely dispensed with on the Ship Railway.

Comparing the Ship Railway with the Nicaragua Canal, the following are the advantages of the former. The road-bed of the railway is *above the water* and is not subject to the effects of the dangerous floods, or the immense slides from excavations; the road-bed to be maintained is of much less width than the prism of the canal, and the material required is handled with less expense. The enormous expense of maintaining a ship canal on the American Isthmus is evidenced by the estimate of Mr. De Lesseps, that it will cost \$7,000,000 per annum to maintain the Panama Canal. The cost of towing vessels or propelling steamers through the canal is considerably greater than their transportation on the railway.

THE SUPERIOR ADVANTAGES OF THE TEHUANTEPEC ROUTE.

The distance in an air-line from the mouth of the Coatzacoalcos river, the terminus of the Ship Railway, to Grey-

town, the terminus of the Nicaragua Canal, is as great as the distance from the mouth of the Coatzacoalcos to New Orleans, or from New York to Jacksonville, Florida, or St. Louis, or Cape Breton. These comparative distances show how immensely superior is the location of the Ship Railway to that of the Nicaragua Canal, especially between all our Gulf and Pacific ports, as this distance of 800 miles must be nearly doubled. This distance and the time required, added to the long time required to pass through the Nicaragua Canal, shows the immense advantage of the railway in these respects.

Another advantage, not to be lightly considered, is the defensibility of the Tehuantepec route. Both harbors are landlocked ; both are easily capable of defence by fortifications ; both can be reached quickly by railroads traversing the Republic of Mexico ; the straits of Yucatan and Florida can be easily defended by our Navy, and we may depend upon the assistance of the strong neighboring republic in whose territory the Ship Railway lies, and we may also rely upon her encouragement and assistance in promoting in every possible way this interoceanic transit-way.

CORRESPONDENCE
BETWEEN
GENERAL U. S. GRANT AND MR. JAS. B. EADS,
WITH A
REVIEW OF THE SAME BY MR. EADS,
SHOWING THE PERVERSION AND UNWARRANTED USE OF THE CORRESPOND-
ENCE BY ADMIRAL AMMEN.

See Page 29.

[*From the New York Herald, March 5th, 1886.*]

MEXICAN SOUTHERN RAILROAD COMPANY,
NEW YORK, *Jan. 13, 1882.*

Captain J. B. EADS, *Washington, D. C.:*

DEAR CAPTAIN: Until I met you in the city of Mexico and had conversations with you there, and subsequently, on the subject of your Inter-oceanic Ship Railroad and read some of your pamphlets upon the subject, I had thought that I saw insurmountable obstacles in the way of the success of your enterprise. You so far removed my doubts about the practicability of carrying ships with cargoes securely by rail, that, while I was not sanguine that it would prove a success, I yet was not prepared to say that it might not be.

I am of that opinion still, but at the same time you gave me to understand that no guarantee was to be asked from the Government until a section of ten miles of the railroad was built, and had carried a vessel of the capacity of 2,000 tons burden to the terminus at the rate of ten miles an hour and returned at the same rate of speed, and had landed the vessel safely in water, when the Government was to guarantee three per cent. interest upon \$5,000,000. Upon the completion of a second ten miles of the railroad a vessel of 2,500 tons burden, with her cargo, was to be transported to the terminus at the rate of ten miles an hour, and again returned to the water at like speed, without injury, when a second instalment of \$5,000,000 of bonds were to be guaranteed for a like interest and on the same conditions. At the completion of each section for ten miles the like test was to be applied with vessels, increasing 500 tons with each section,

until one with her cargo of 4,000 tons should be transported to the terminus of the road and into the water; and on completion and the success of each section of ten miles the like interest on \$5,000,000 of bonds were to be guaranteed by the Government until the whole amount should reach \$50,000,000.

I have felt a very great interest in the matter of communication between the Atlantic and Pacific oceans somewhere in North America, and which should be mainly under the control of the United States Government and United States capital. To that end, with the valuable aid of Admiral Ammen, I had succeeded in having all of the well known lines of low level between the United States of Columbia in South America and Tehuantepec surveyed, and had submitted the result of the surveys to a board of engineers, which I convened. That board, on an examination of these various reports, reported that no other route was practicable for a ship canal as compared with the Nicaragua route. From that time on I became interested in seeing that work undertaken by an American company, not caring who it was done by so that it was done, but willing to lend my name to the enterprise because there is no problem whatever as to the practicability of the route and no difficulty in doing the work if the capital can be secured for it.

But your proposed work accomplishing the object which I had in view, and seeming to have followers who might be willing to furnish the necessary capital, I was induced on your statements to say to Admiral Ammen and to Captain Phelps that with money appropriated for the De Lesseps canal, by the way of Panama, and the following you had for your road, it was idle for us to try to enlist capital in a third enterprise of this kind, and as you asked nothing from the government more than a guarantee that your road earned three per cent. upon fifty millions of capital, if it could carry vessels of 4,000 tons burden successfully from ocean to ocean and without injury to the ships, I thought the Government was running no risk whatever, and advised that we should let the matter drop until either the two enterprises under construction and in contemplation were exploded or proved a success. If yours should prove a success the Nicaragua Canal would not be wanted at all, at least not in the near future.

But I now have your bill—No. 430—before me, and see that its provisions are so entirely at variance from what I had been led to suppose you intended to ask that I feel it my duty to notify you that I shall oppose it in its present form with all my ability. I do this because I feel that I have been deceived as to what you intended to ask, and also believe that if your present bill passes the Government will be made responsible for six per cent. interest upon a large bonded indebtedness even if your enterprise should prove a total failure.

In the first instance the speed with which vessels were to be safely transported is changed by this bill from ten miles to six miles an hour; the rate of interest upon the bonds guaranteed is changed from three per cent. per annum to three per cent. semi-annually; the vessels transported of the

named tonnage are to be vessels with their cargoes weighing the amount of what I supposed was to be the tonnage of the vessels. I do not think the change of ten miles to six per hour, or even to four, a serious objection; but the change in the class of vessels transported and in the rate of interest asked are very serious changes.

Then, also, in your bill you provide what I would approve of for using rivers and canals as far as it was practicable to do so, and to shorten the line of railroad simply to what would be necessary to get over the elevation dividing the two oceans. An examination of the map shows that by deepening the mouth of the Coatzacoalcos river six feet you have a navigable river for all the vessels you propose to carry for thirty miles. From thence to the foothills, through a flat and marshy country where the amount of excavation will be a minimum, you will have a still greater distance where a canal can be cheaply constructed. In like manner on the Pacific side, with a little deepening at the mouth of a slough or small lagoon, connecting with the Pacific, and by deepening between that and another lagoon inland, and a canal through a flat and low country to the foothills, in all a distance of twenty to thirty miles or more, ships of the classes you propose to carry can easily be transported. All this leaves the extent of ship railroad to be built probably less than one-fourth of the entire distance across from the Gulf of Mexico to the Pacific ocean.

Your bill provides that the same subsidy shall be guaranteed for water communication that is allowed to the railroads, and the same rate of speed, viz., six miles an hour, is not mandatory in the canal.

This would give you, by the terms of this bill, a guarantee of \$5,000,000 for the first ten miles, which would be river navigation from the Gulf of Mexico, and a like sum for the first ten miles from the Pacific coast, likewise of water navigation, nearly completed by nature.

The balance of the route is to be divided up into twenty sections of equal length. Whenever any one of them is completed on either side bonds to the extent of \$2,000,000 are to be guaranteed for each section as completed.

All this would insure to you or to the company that you represent a guarantee of from thirty to forty millions before it would be necessary to enter upon that portion of the work which is in any degree problematical—viz., the ship railroad. The Government is bound to provide for this six per cent. interest, whether the railway and canal earn it or not, for fifteen years after the completion of the road.

Now it looks to me very much as if that portion of the work about which there can be no difficulty might be completed, these thirty to forty millions of guaranteed bonds secured and the work stop entirely, and as it never would be completed, there would be a six per cent. irredeemable bond for which the Government would be responsible for the interest fastened upon it.

Now, I know, Captain, that you are enthusiastic and have full faith in the feasibility of the work you propose. I am satisfied, further, that if the matter was left entirely to you, you not only would spend every dollar that you could realize out of the bonds in proving the feasibility of your plans

of transporting ships, but you would spend all the private means that you could in any way raise, by hypothecating the second mortgage bonds, or even your private estate.

But you must recollect that this is a company, will have directors, will be controlled by the capital that is put in it, and even if there was a possibility of the success of your enterprise by the expenditure of a large sum of money, the stock of this company might be held by men who would be satisfied with the thirty to forty millions they had already received and would oppose any further progress of the work or expenditure of the means, because at the expiration of fifteen years after the completion of the work the Government would cease to be responsible for either the principal or interest of these bonds.

I have felt it my duty to state these objections to you, because you had reason to understand that while I might do nothing to favor your project (because I was not entirely satisfied with its feasibility) I would not antagonize or oppose it. Now that I have concluded that I must oppose it, you should know it first.

I was somewhat surprised when I saw Senate bill No. 550, to incorporate the Maritime Canal Company of Nicaragua, was introduced. I supposed what I had said to Admiral Ammen and Captain Phelps would probably prevent anything being done in the way of inaugurating that company until, as I suggested before in this letter, the other enterprises for interoceanic ship communication had proved a failure, and my first impulse was to write to Senator Miller, stating frankly what I had said to these gentlemen, and what my ideas were on the subject; but fortunately I was so pressed for time for a few days after the bill was introduced that I could not take the matter up, and afterward forgot it, until I saw your bill, of which I am now speaking, and I confess to you I was very glad that I had not written the letter which I had contemplated writing, and I shall take the liberty of furnishing Senator Miller a copy of this letter.

Assuring you that I have no pride in the establishing of any particular line or route for the transportation of vessels between the two oceans, but only to see the work done, and do not care by whom it is done provided it is under American auspices, and that I should wish your enterprise the same success that I would if my own name was connected with it if inaugurated on terms that were not going to make the Government responsible for any failure.

I am very truly yours,

U. S. GRANT.

[The *Times-Democrat* of New Orleans published the following letter April 11th, 1886, as the *N. Y. Herald* refused to print it, although it had just given to the public the preceding letter of General Grant.]

THOMASVILLE, GA., *April 3, 1886.*

EDITOR OF THE NEW YORK HERALD:

DEAR SIR: During the last sixty days, a pamphlet entitled "The Certainty of the NICARAGUA CANAL Contrasted with the Uncertainties

of the EADS SHIP RAILWAY, by Daniel Ammen," has been extensively circulated in Congress and throughout the country. This pamphlet is full of gross misstatements respecting the Ship Railway, which, on account of the high naval rank of its author, are calculated to gravely mislead the public. About six pages of it are devoted to such offensive personalities and billingsgate in relation to myself, as to forbid any controversy whatever on my part with its author. I only notice the pamphlet to correct the impression likely to be created by the following extract which it contains from a private letter addressed to me by General Grant on the 13th of January, 1882, relative to the Ship Railway bill then pending in Congress:

"But I now have your bill—No. 430—before me, and see that its provisions are so entirely at variance from what I had been led to suppose you intended to ask, that I feel it my duty to notify you that I shall oppose it in its present form with all my ability. I do this because I feel that I have been deceived as to what you intended to ask, and also believe that if your present bill passes, the Government will be made responsible for six per cent. interest upon a large bonded indebtedness even if your enterprise should prove a total failure."

The purpose of Admiral Ammen in publishing the above is to create in the public mind the belief that I deceived General Grant in 1882, just as he is now endeavoring, by grossly distorting its provisions, to make the public believe that I am striving to deceive it with the present Ship Railway bill. This pamphlet states that this private letter will soon be published. Accordingly, on the 5th ultimo, it appeared in full in the New York *Herald*, and naturally elicited many unjust comments from other newspapers throughout the country. As you have given widespread currency to General Grant's letter, I beg space for this communication, which, owing to my recent illness, has been unavoidably delayed.

To enable the reader to know who deceived General Grant in this matter, it is necessary to state certain facts before submitting the reply made to his letter.

During the last twenty-two years of General Grant's life our friendship was of the most cordial character, a fact attested by his private letters to me, the last of which is dated May 13th, 1884, more than two years after the date of the one above referred to. During this period he gave many proofs of his great confidence in my judgment and abilities as an engineer. Within the last month I have received a letter from a distinguished Confederate officer, containing a reference to a conversation with Gen'l Grant on the subject of the Isthmus problem as late as 1885, during which he says Gen'l Grant declared that he considered Mr. Eads the very highest authority upon that subject in the world. During the last days of his administration I talked with him fully and freely upon the importance of a ship transit across the Isthmus, and told him that on the completion of the Jetties I intended to devote myself to its solution, as a legitimate supplement to that work, as it would virtually extend the Mississippi river into the Pacific. I referred to the immense benefit he could confer on his

country and mankind by lending his great influence in accomplishing the proposed work. I expressed no preference at that time for any one of the routes, but suggested that his prominent identification with the enterprise would be a legitimate sequence to the deep interest he had shown during his official career in the Isthmian problem and in the opening of the Mississippi river. He expressed an earnest wish to aid the undertaking, and said that on his return from his contemplated tour around the world we should talk more definitely on the subject.

During Gen'l Grant's tour I took up the study of this problem and finding that the distance between the mouth of the Coatzacoalcos (the entrance to the Tehuantepec route) and Greytown (the entrance to the Nicaragua route) was as great in an air-line as the distance from New York to the Gulf of Mexico at Tallahassee, I saw at once the immense advantage in point of location possessed by Tehuantepec. I then satisfied myself that while a canal was not practicable at Tehuantepec, it was practicable to carry ships over that Isthmus by railway. Further studies satisfied me that their transportation by rail would be really more economical, and for several reasons more desirable, than through a canal with locks. I was further convinced that there would be no advantage to American commerce by this long and much more distant canal with locks, over the short sea-level cut proposed by De Lesseps at Panama. I saw also that a *very serious objection* to the Nicaragua canal existed in the fact that the harbor at Greytown, once possessing an entrance depth of about eighteen feet, had been obliterated by the sands of the sea and the local drainage of the tropical floods, in consequence of the almost total abandonment of that harbor by the San Juan river, which had been gradually directed into another channel, (the Rio Colorado,) which now conveys almost the whole flood waters of Lake Nicaragua through Costa Rica to the sea about twenty miles further east than Greytown. The restoration of this obliterated harbor on the sandy coast of Nicaragua is therefore a very different problem from that of the improvement of any existing harbor on the Atlantic seaboard. It is, in fact, the creation of a new harbor where none exists. Natural harbors on sandy sea coasts are always kept open by the flood discharges of rivers, or by the tidal discharges from estuaries, sounds, or other tidal basins. From New York to Mexico nearly all of our harbors are of this kind, and the almost fruitless attempts to improve them after years of study and the expenditure of many millions attest the uncertainty of such efforts. To undertake the creation of a harbor among sand banks where none exists, and where neither of the two natural forces are present to aid such effort, and to maintain the harbor intact afterwards, must necessarily be still more uncertain.

Seeing Gen'l Grant's name announced before his return, as the probable president of the Nicaragua canal company, I wrote to him soon after his arrival, and pointed out these objections to the proposed canal, and urged him to have nothing to do with it, assuring him that they would certainly prevent its construction during this century, and that I did not want to see

him couple his name with what I felt sure would be a failure. In the letter I assured him that a ship railway would be made across Tehuantepec, and that for many reasons it would be preferable to a canal. Subsequently, in Mexico, in New Orleans, and in New York, during personal interviews in 1880 and 1881, I impressed upon him these views and my conviction that he would never live to see the building of the Nicaragua canal.

General Grant knew but little of the principles of mechanics, or of hydraulic engineering, and was not qualified by experience or education to judge of the practicability of a ship railway, nor of the engineering difficulties at Nicaragua. His son Jesse was educated as an engineer and quickly recognized not only the feasibility of the ship railway, but its advantages over the canal. He greatly regretted the use of his father's name in opposition to the ship railway, the success of which he thought certain. No doubt his arguments, coupled with the opinions I had expressed, induced his father to assure Hon. A. G. Cochran, the counsel of the Ship Railway Company, about the 1st of January, 1882, that he would write to Senator Miller to take his name off the Nicaragua canal bill. Soon after this promise, the letter Ammen has published was received by me. I immediately sent, by Mr. Jesse R. Grant, the following reply:

WILLARD'S HOTEL,
WASHINGTON, D. C., *Jan. 21, 1882.*

GENERAL U. S. GRANT,
New York City:

DEAR GENERAL: I have the honor to acknowledge receipt of your letter of January 13th, in which you inform me that you feel it your duty to oppose the Ship Railway Bill. * * *

Appreciating the deep interest which you had always taken in the advance of American Commerce, and remembering your great anxiety, both in public and private life, to bring about a solution of the Isthmian problem, I felt very desirous that you should fully understand my project, what I proposed to do, and what aid from the Government I regarded as necessary. Hence it was that when I met you in Mexico, and afterwards on our journey home, I discussed the whole matter freely with you. I need hardly say that when I succeeded in removing your doubts as to the practicability of the work I was greatly gratified.

You point out in your letter certain objections to the bill recently introduced before Congress which, you say, have decided you to oppose its passage.

You will no doubt remember that when returning home on the steamer, I handed you a copy of the bill reported by the Inter-oceanic Committee to the last Congress. You read the bill and I had no reason to suppose that you failed to fully understand it. The Government guarantee therein provided for, was a three per centum semi-annual guarantee, not of interest upon bonds, but of stock dividends.

There were also provisions as to a canal, and payments for the same as in the case of the Railway. You remarked at the time that you did not think I would have much difficulty in passing the bill as it left no risk on the part of the Government in relation to the practicability of the railway. I now enclose you a copy of the bill I then showed you, and am satisfied that when you compare it with the bill more recently introduced, you will find that they substantially agree. If there be any difference I think that the latter bill is, in some respects, even more favorable to the Government.

As I understand it you have two serious objections to the bill, and they are as follows, viz :

1st, That the Company might never complete the work, and in this case, under its guarantee, the Government would be required to pay for an indefinite period.

2d, The liability of the Government might be made to attach to a large amount, for the construction of a canal merely, and without the practicability of a Ship Railway ever having been demonstrated.

I am unwilling to admit that the bill can be fairly made to bear this construction, but will not stop to argue the point, because I freely concede that the existence of the *slightest* doubt upon the subject renders a proper amendment imperative. I certainly never intended that any such construction should be placed upon the bill and shall see that the language is so changed as to make this construction impossible. I am willing that positive provisions shall be put into the bill to the effect that under no circumstances shall the Government pay upon its guarantee for a longer period than twenty years from and after the date of the testing of the first ten miles of railway and that no portion of the guarantee shall apply to any canal until the practicability of the project shall have been demonstrated by the successful transportation of a loaded vessel over ten miles of the railway.

I never contemplated the construction of a canal over any considerable distance of the route, and am very sure that under no circumstances will all portions of the canal, taken together, (if indeed any canal at all be constructed,) equal a distance of ten miles.

The bill certainly does not provide that the improvement of the river shall entitle the Company to the benefit of any part of the guarantee. I am satisfied that no such construction could be sustained for a moment, and yet I am entirely willing that a provision shall be incorporated into the bill concerning the matter in express language.

There are other minor matters mentioned in your letter, but as you have informed me verbally that you do not regard them as important, I will not weary you by referring to them.

Will you kindly advise me, by early mail, whether, if the bill be amended in accordance with the suggestions herein contained, you will not be willing to withdraw all opposition to it?

I feel satisfied that I shall build the Ship Railway, and I know that I can, and will, make it a complete success. Believe me, I would be unwilling to stake my reputation upon a doubtful experiment, or identify the closing years of my life with a failure. I am deeply anxious that when the Railway is in successful operation you shall be classed among its earliest and strongest friends.

Soliciting an early reply, I am, dear General,

Very sincerely yours,

(Signed)

JAS. B. EADS.

Two days after the date of this letter I received the following :

NEW YORK, Jan. 23, 1882.

DEAR SIR: I showed your letter to father, and he expresses himself as satisfied with the letter, and I have just wired you to that effect. He has written to Miller explaining the error he made.

Very respectfully,

(Signed)

J. R. GRANT.

To J. B. EADS, ESQ.

On the same day I received the following telegram :

“ Letter received. Satisfactory. Sent copy to Miller. J. R. G.”

Soon after this I received a brief letter from Gen. Grant (now mislaid) assuring me that he would not oppose our bill.

The letter of General Grant of Jan. 13, 1882, is a rehearsal of the mis-constructions and misrepresentations published at the time by Ammen and Phelps regarding the ship railway bill then pending. As Ammen had a copy of his letter it is not to be supposed that he was ignorant of my reply, or of General Grant's admission that he was in error; and the fairness of Ammen's methods may be inferred from the fact that he has continued to use this letter to give color to his misrepresentations of the bill, after Grant had written to Senator Miller explaining the error he had made regarding it. J. R. Grant's letter proves that his father did this *immediately* after receiving my letter, which fact Ammen has carefully suppressed. He says in his present pamphlet he read the letter to Hon. A. H. Stephens, of Georgia, who said in reply :

“ Now I understand it all. Captain Eads would, under his bill, construct his ship railway without any cost, and indeed with a very considerable endowment, and then without ever attempting, or indeed intending to pass a ship from sea to sea, would have several lines of railway and harbors for small vessels, and a very profitable traffic in grain and other merchandise.”

If Mr. Stephens ever said anything so unjust it simply proves that he never examined the bill and was grossly deceived by Ammen, for the bill was, soon after the date of Grant's letter, unanimously reported by the Senate committee on commerce to the Senate, with a strong report in its favor; and an equally favorable report was made by the House committee on Inter-oceanic Canals on this same bill which Ammen would lead the

reader to believe was such a transparent fraud. These committee reports were made, too, in defiance of the utmost efforts of Ammen and his coadjutors to prevent them. The most that they did accomplish was to divide the majority who were in favor of some one or other isthmian transit for ships, and thus prevented action upon either bill during the 47th Congress.

Two or three weeks after this correspondence I wrote to Jesse R. Grant as follows :

“The sub-committee (five members of the committee of commerce of the Senate) have agreed to report unanimously in favor of the Ship Railway bill, and the full committee have authorized the printing of their report before final action is taken on it. * * * In the meantime, Ammen is doing all he can to defeat us. You will see by the enclosed slip, cut from the latest New Orleans newspaper, that U. S. Grant, Sr., and U. S. Grant, Jr., still constitute the Alpha and Omega of his forces, and are to share the honor of opposing the Ship Railway bill so long as he can keep them thus prominently before Congress and the country. Of course, I regret this for several reasons: 1st. Because I do not like to see the honored name of General Grant so prominently identified with a project which will inevitably prove a failure, even should Congress fail to pass my bill. 2d. Instead of occupying the impregnable position of a patriotic promoter of an isthmian highway for ships, whose great influence, official power, and high position were directed to the solution of the question, it places him in the attitude of a partisan, opposing a project for solving the problem which is supported by an overwhelming mass of expert testimony, and which avails of a location not only admitted by every one to be much superior to Nicaragua, but in a territory in which he has already important individual interests, whose inhabitants are his friends, and who are earnestly desiring to see the consummation of the enterprise which he seems to be opposing. 3d. I regret it because it gives color to the numberless misstatements that have been published throughout the country, to the effect that I had received a letter from General Grant upbraiding me with having deceived him as to the terms of my proposition, in consequence of which he had withdrawn from the directory of my company [in which he was never interested.] No less than three different articles to this effect were shown me yesterday, cut from recent newspapers. 4th. I regret it, because having assured me in his last letter that he would throw no obstacle in the way of my measure, this use of his name by Admiral Ammen keeps in its way the most serious obstacle which it has to encounter, and furnishes to Ammen the only possible means with which he can hope to defeat my bill. He totally disregards the advice of your father and is determined to use his name as long as he will permit it.

“As the Ship Railway becomes more and more popular, some of the blackmailers become more and more desperate and vicious. I send you a slip referring to the republication of a scandalous letter published two or three years ago; to-day the same paper republishes the libellous statement published by a New York paper against me about three years ago, and which it afterwards retracted.”

The reader can judge of the spirit which prompts Admiral Ammen now, from the fact that he refers in his last pamphlet to this stale slander, long since refuted and retracted, and which, if true, could not possibly affect the merits of the canal or the ship railway.

Gen. Grant says in his letter of Jan. 13, 1882 :

“I was somewhat surprised when I saw Senate bill No. 550, to incorporate the Maritime Canal Co. of Nicaragua. I supposed what I had said to

Admiral Ammen and Capt. Phelps would probably prevent anything being done in the way of inaugurating that company until, as I suggested before in this letter, the other enterprises for interoceanic ship communication had proved a failure."

In bill No. 550, Gen. Grant's name was placed at the head of the list of incorporators, and the above extract proves that this use of it was made without his knowledge or consent by Ammen and Phelps, who were then interested with Menocal and other officers of the Government in the concession from Nicaragua.

The following additional extracts from the letter prove that he had no pecuniary interest with these parties at that time in their concession, if indeed he ever had :

"I have felt it my duty to state these objections to you because you had reason to understand that while I might do nothing to favor your project (because I was not entirely satisfied with its feasibility) I would not antagonize or oppose it. * * * Assuring you that I have no pride in the establishing of any particular line or route for the transportation of vessels between the two oceans, but only to see the work done, and do not care by whom it is done provided it is under American auspices, and that I should wish your enterprise the same success that I would if my own name was connected with it, if inaugurated on terms that were not going to make the Government responsible for its failure.

"I am very truly yours,

"U. S. GRANT."

The following reply of Admiral Ammen to a Senator who wanted Gen'l Grant for the third term, gives the secret of this persistent use of his name by the holders of the Nicaragua concession. It will be found in the North Am. Review, Nov., 1885. I have italicised a portion of it :

"Senator, There are a great many who would make good presidents, you among the number; I will be glad to vote for you if nominated, *but Gen'l Grant only in my belief can speedily bring about the construction of the Nicaragua Canal.*" * * *

The closing sentence of Gen'l Grant's letter expressed his true position on the Isthmian question. He had no pride in establishing any particular route between the two oceans, but only to see the work done; he cared not by whom, so it was inaugurated on terms that would not make the Government responsible for its failure. These are the utterances of a true patriot actuated by no pride of opinion or self-interest, but anxious that his country and the world should enjoy at the earliest moment the benefit of a ship transit somewhere across the Isthmus. While he was living, Admiral Ammen strove to place him in an entirely different position before the world. Now that he is dead, he makes an unwarrantable use of a private letter written four years ago under a total misapprehension of facts (which he promptly acknowledged) to make the public believe that he was opposing the Ship Railway bill in 1882, when in fact he had verbally assured Mr. Cochran that he would not oppose it; had writ-

ten to me that he would place no obstacle in the way of its passage, and had given the same assurance to his son Jesse.

He would make the country believe, even now, that Gen'l Grant was, like himself, and his partners, Phelps, Menocal, Merry and other less prominent owners of the concession to Menocal, an interested advocate of a canal scheme, (of questionable feasibility and merit,) and the leading partner of a party of impractical government officers, said to be nine in number, (with other associates less creditable,) who had used their official influence to have their route surveyed and resurveyed at the public expense, without authority of Congress to increase, if possible, the cash value of their concessions from Nicaragua. Now that their project has totally failed, their concession having expired, the chagrined and embittered Admiral strives to defeat the Ship Railway bill by misrepresenting the true sentiments of the dead hero, and by the suppression of facts would now lower him to the same selfish and unenviable level with himself and his less prominent coadjutors. The final wrecking of their scheme in May, 1884, is thus related by one of them, Capt. Merry, of San Francisco, according to the Chronicle of that city:

“A syndicate of New York and San Francisco capitalists had been formed to aid the construction of the canal under the Menocal concession, of which syndicate Gen'l Grant, Mr. Fish, the president of the bank, and others interested in that institution, were members. Admiral Ammen had taken up his pen to affix his signature to a construction contract, when a boy rushed in and announced the failure of the Marine Bank. Foreseeing the consequences of that failure, Admiral Ammen laid down his pen, and being unable to obtain the necessary financial aid our concession was allowed to expire.”

“*Sic transit gloria mundi.*”

JAS. B. EADS.

