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THE TEHUANTEPEC ISTHMUS RAILWAY

BY

SEÑOR DON MATIAS ROMERO

MEXICAN MINISTER AT WASHINGTON

AND

MR. E. L. CORTHELL

CIVIL ENGINEER

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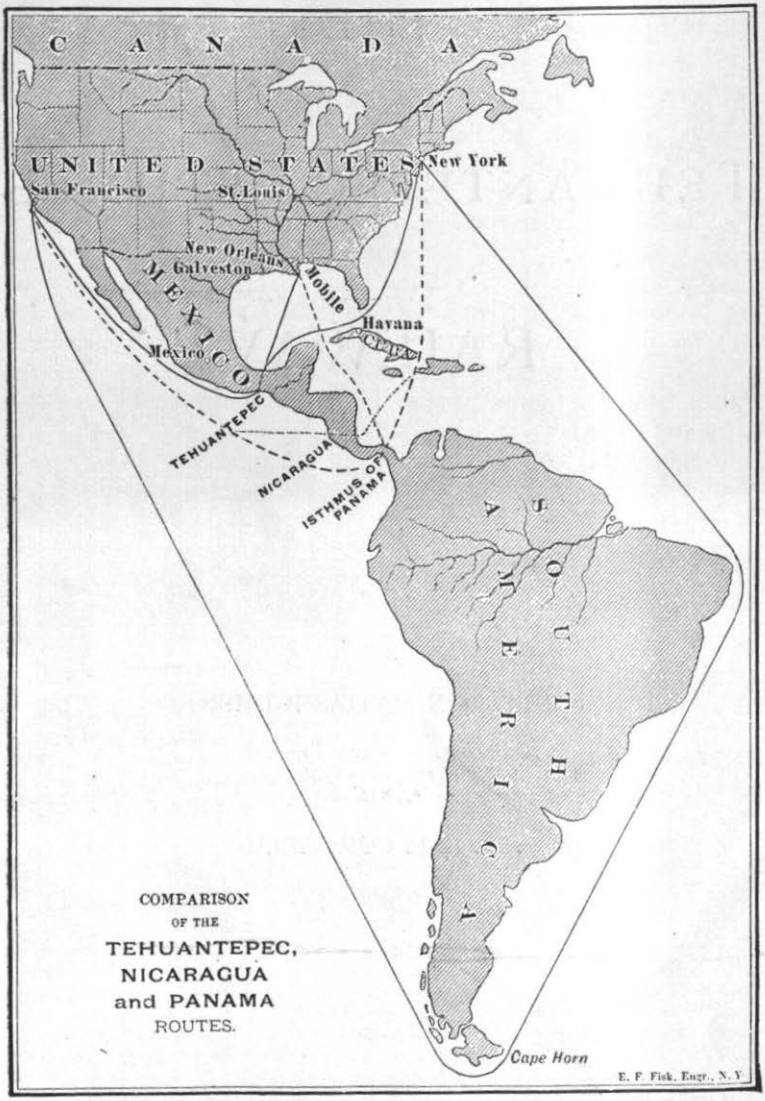
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TEHUANTEPEC
NICARAGUA
ISTHMUS OF PANAMA
SOUTH AMERICA
Cape Horn
COMPARISON
OF THE
TEHUANTEPEC,
NICARAGUA
and PANAMA
ROUTES.
E. F. Fisk, Engr., N. Y.

THE TEHUANTEPEC ISTHMUS RAILWAY.*

MY desire to comply with the request of the editor to write an article on the Tehuantepec railway, now nearing completion, has determined me to prepare a brief sketch on that subject, which will, however, necessarily reflect the haste with which it has been penned, and will express only my personal views thereon.

In writing these lines I am not guided by a spirit of either jealousy or hostility toward the Nicaragua canal. I am persuaded that the canal offering the best conditions will finally be the first built, and therefore that any reasoning tending to disregard this circumstance is idle. If the Nicaragua canal offers the best conditions it will be the first to be built, no matter what reasons or objections may be presented in opposition to it.†

I believe that while Nicaragua would offer more facilities for a canal than Tehuantepec, it would be easier to construct across the latter isthmus a ship-railway, and that the opening of both routes, far from conflicting with each other, would be favorable to the commerce of the world as furnishing two different ways, each with especial advantages for crossing the American continent. Not having myself any pecuniary interest in these schemes, I see them from a higher standpoint, considering only their usefulness to the whole world. I also believe that neither work will obtain any pecuniary assistance

* The first edition of this article was published by the *Engineering Magazine* of New York, in its number for March (1894), and in Spanish by the *Universal*, a newspaper of the City of Mexico. The article was afterward corrected and completed, and as it is now published contains all the facts connected with the subject, some inaccuracies in the first edition having been rectified.

† On February 8, 1888, I gave to a reporter who interviewed me in reference to the merits of the Tehuantepec route, as against the Nicaragua and Panama, the following memorandum of an interview, which fully expresses my present views on that subject:

"I have taken little interest in the fight and jealousies about the American isthmus, because I believe that this question has to be decided only by its natural, geographical and commercial bearings. There are three principal routes across the isthmus, over which canals or ship-railways have been projected, viz., Tehuantepec, Nicaragua, and Panama. If the present needs of the world's commerce, or its future extraordinary development, require that the three should be opened, and if this is at all practicable, they will be built, whatever may be the obstacles in the way. If one or two are impracticable, for their immense cost or other reasons, it is not likely that they will be built whatever may be the wishes of the nations over whose territory the canal may pass. Mexico certainly would not mourn the completion of any of the other routes, because the opening of either will necessarily benefit the neighboring countries, and in this respect, whatever may be the issue of the question, all American nations will be profited by the completion of any of the intended routes. We believe that we have in Tehuantepec as good a chance for such a work as in any other part of the isthmus, and we wait patiently the result without showing petty jealousy or a spirit of opposition to the other schemes."

from the United States, because, in my opinion, in the present temper of the people of this country, no money will be expended in any work of public improvement outside of its own territorial limits.

Great importance has always been attached in Mexico to the subject of interoceanic communication through Tehuantepec. As far back as the time when Hernando Cortes conquered Mexico and passed through Tehuantepec in his expedition to Honduras, he tried to find a natural pass, like the Straits of Magellan, connecting the Atlantic with the Pacific. Cortes then personally examined the isthmus of Tehuantepec hoping to find that passage. Recognizing the important geographical advantages of the isthmus, he believed confidently that the time would come when a route would be established there between the two oceans. The railroad now being built on the isthmus passes through the lands which, on his application, were donated to him by the emperor, Charles V., and which are now divided into three estates called La Venta, Chicapa and Tarifa, which constitute the Haciendas Marquesanas, named so because Cortes had been made by the emperor Marquis of the Valley of Oaxaca. During the three centuries of Spanish domination this project was in abeyance, because the policy of the metropolis was opposed to all communication of the colonies with the outside world, and the opening of an interoceanic canal was in direct conflict with that policy.

Notwithstanding that fact,—and possibly in pursuance of that policy, either to find out whether there was a natural passage between the two oceans, for the purpose of closing it, or, if there was not such a natural channel, not to open an artificial way, or perhaps desiring a canal for the exclusive benefit of its navy,—the Spanish government caused serious studies to be made with a view to finding a natural passage or to ascertain whether one was practicable to connect the Atlantic and Pacific oceans through the American isthmus. Under Philip II. in the sixteenth, and Charles III. in the eighteenth centuries, careful surveys were made which were remarkable for their accuracy, taking into account the state of science at that time. A complete survey of the Coatzacoalcos river was made in 1610, which together with a map of that river was published in the June, 1882, number of the Bulletin of the Geographical Society of Madrid. The voyage of Baron Humboldt to America at the beginning of this century again awakened great interest in this enterprise, as was exhibited by the action of the Spanish Cortes after the Napoleonic wars.

When the independence of Mexico was accomplished, the first Mexican congress, by an act of October 14, 1823, organized an independent province of the isthmus of Tehuantepec, which then, as at present, comprised parts of the provinces, now states, of Oaxaca and Vera Cruz.

The Mexican congress which convened to frame the constitution, adopted October 4, 1824, passed an act on November 4, 1824, providing that the executive should call for proposals for the opening of a route across the isthmus of Tehuantepec, and requesting the executive to collect all necessary information to provide for the building of a canal.

In my opinion the advantages resulting to Mexico from the interoceanic communication were overestimated, since it was thought as stated in the preamble of the grant made by Mexico to Don José de Garay on March 1, 1842, that "the opening of the Tehuantepec route would make Mexico the center of the commerce and navigation of the world." Without denying that such communication is bound to produce results favorable to Mexico, especially in developing commerce and industry on her coast line near the isthmus, I believe, nevertheless, that such expectations were very much exaggerated, and my belief is based on what has happened with the railway across the isthmus of Panama, which has kept open for several years communication between the two oceans. In my judgment the Central American States, in whose ports ply the steamers running between San Francisco and Panama, have been more benefited by that road than Colombia herself, or even the State of Panama, as they have developed their agricultural production and a prosperous traffic to their great advantage, giving value to their lands, work to their people, and a remunerative result to their enterprises, while no marked advantage has accrued to Colombia or Panama. The same experience is shown in Egypt with the Suez canal.

But Tehuantepec has some peculiar advantages which after a time are bound to give it great importance. It not only possesses a healthful climate and a fertile soil, but it is the indispensable pass of the Inter-American railway which will extend from Canada to Tierra del Fuego, and the interoceanic railroad over that isthmus will not be isolated but will make of Tehuantepec an important commercial center. The Mexican Southern Railroad will connect Tehuantepec with the City of Mexico by the way of Oaxaca, and the Cordova and Tuxtepec railroad will connect it with the capital by the way of Vera Crux, and the Pan American railway will place it in communication with North and Central and South America.

The protracted and bloody struggle sustained by Mexico in order to shake off colonial principles and church rule, and to follow the pathway of progress, precluded for nearly twenty years any effort in the direction of interoceanic communication. However, as soon as there was a respite in the civil struggle, the project was taken up again. On March 1, 1842, General Don Antonio Lopez de Santa Anna, at that time dictator of Mexico, granted a charter to Don José de Garay, to

open communication across the isthmus of Tehuantepec, by water as far as practicable and for the rest of the way by rail, beginning the work by a survey of the land and location of the road which was to be done within eighteen months from the date of the contract. Señor Garay entrusted the surveying work to Señor Don Gaetano Moro, an able Italian engineer, who accomplished it very satisfactorily, this being the first scientific survey of the projected road made after Mexico achieved its independence.

The decree of March 1, 1842, just alluded to, which was the first concession made to Garay, provided for the opening of a road through Tehuantepec, and entrusted the building of the same to Señor Garay. That concession was enlarged by a new grant of land, given by a decree of February 9, 1843. Another decree of October 3, 1843, provided for the establishment of a prison in Tehuantepec with 300 convicts to help in the construction of the road; and still another decree of December 28, 1843, extended for one year longer the term of ten months agreed upon in the first grant to begin work on the road after the survey was made. The term expired on June 30, 1845, and that ended the Garay grant, for non-compliance with its provisions, for although he applied to congress for a new extension of the time of the concession, which was granted by the house of representatives in December, 1845, it never was voted upon in the senate. But on November 5, 1846, General José Mariano de Salas, president of Mexico, acting under extraordinary powers, issued a decree ratifying all previous concessions made to Garay, enlarged the land-grants and extended for two years from the date of that decree the term for beginning the work. This decree was declared void and null by an act of the Mexican Congress of May 22, 1851, to which reference will be made later, on the ground that the president in issuing it had exceeded his powers.

Notwithstanding all these privileges granted to Garay by the Mexican government, he did not even begin the work under the time fixed, because he could not command the necessary capital. During the progress of our war with the United States, in 1846–47, Señor Garay sold his charter to Messrs. Manning and Mackintosh and John Schneider of London, who, after the war, sold it to a New York company headed by Mr. Peter A. Hargous, but the Mexican government contended that Garay's charter had been forfeited for want of compliance with its conditions, and that all transfers made by him were null and void, not only on that account, but also because the permission of the government to transfer the grant had not been obtained. At the end of that war, by the treaty of Guadalupe Hidalgo of February 2, 1848, the United States acquired an extensive coast on

the Pacific ocean, and it became necessary for them to have a short way of communication between their Atlantic and Pacific coasts. Naturally it was thought that Tehuantepec offered the greatest advantages, although the United States, having foreseen that need, had negotiated a treaty with New Granada, signed at Bogota December 12, 1846, in which passage across the isthmus of Panama was guaranteed to them, with other very liberal concessions. For these reasons the United States made great efforts to obtain from the Mexican government a charter similar to the one they had from New Granada, and they asked for it during the progress of the negotiations preceding the treaty of peace; but the Mexican government, fearing, not without reason, a repetition in Tehuantepec of what had just happened in Texas, did not deem it advisable to make the concession for building the road to a company of citizens of the United States, and answered that, as a grant was already in the hands of the Garay company, the government had no right to dispose of the same.

This answer given by the Mexican plenipotentiaries who signed the treaty of Guadalupe Hidalgo induced the parties in the United States, interested in building the Tehuantepec railroad, to obtain the cession of the Garay charter from Messrs. Manning and Mackintosh, who, in their turn, considering themselves the successors of Sr. Garay, were willing to and did sell their charter to a United States company, who asked the guarantee of the United States government to build the road.

This government requested Mexico to make a treaty for that purpose, and notwithstanding the reluctance of Mexico on this point, at the request of the United States the Mexican plenipotentiary signed on June 23, 1850, a treaty with Mr. Robert P. Letcher, the minister from this country at the City of Mexico, by which both governments guaranteed the neutrality of the isthmus, under certain conditions that were considered sufficient to assure the autonomy and independence of Mexico; but the treaty was rejected by the United States senate, and the United States government asked for a modification of the same, and this request resulted in another treaty, signed January 25, 1851, which was rejected in its turn by the Mexican senate.

The principal cause of the rejection of this treaty was that the government of the United States contended that it guaranteed the Garay charter, which, as already stated, had fallen into the hands of United States citizens, while the Mexican government, far from accepting that view of the case, declared the said concession forfeited, and considered that it would be extremely dangerous for Mexican interests should that road be built by citizens of the United States.

The feeling of distrust against the United States which prevailed

in Mexico immediately after the war of 1846 and 1847 was strengthened by reasons of some filibustering invasions of the border states of Mexico, which occurred about that time, and which the United States government could not prevent. As the people of Mexico did not understand well the laws of the United States, the extent of personal guarantees enjoyed here, and the feeble action of the federal government in the States, it was hardly believed that this government had no power to prevent such invasions.

It is very satisfactory to notice the change in the relations between Mexico and the United States since 1851. The Mexican government at that period not only refused to grant to citizens of the United States a concession to build a railway, but considered it dangerous for engineers from that country to finish the survey which they were making of the isthmus of Tehuantepec. Now, however, almost all the railway concessions given by the Mexican government—and their number is considerable—have been made to citizens of the United States. The principal railways in Mexico, with only two exceptions—those running from Vera Cruz to the City of Mexico—have been built by companies organized in the United States. The idea of permitting the passage of United States troops into Mexican territory in pursuit of hostile Indians was then considered as inacceptable ; indeed, according to a statement of Mr. Letcher, the American minister, made to Señor Don Fernando Ramirez, the secretary of foreign affairs of the Mexican government, United States soldiers then appeared to be more objectionable in Mexico than hostile Indians. Since then, however, that permission has been freely granted and with satisfactory results. This shows that the situation of distrust and even unfriendliness resulting from the war of 1846-47 has given place now to one of mutual friendship and cordiality, as a consequence principally of the change in the political tendencies of the parties in the United States which, since the abolition of slavery, do not seek to annex Mexican territory.

In view of the determination of the Mexican government not to recognize the charter for the building of the road which had come to the hands of a company of citizens of the United States, parties interested in the isthmus transit applied to the government of New Granada, and received from the latter a liberal concession for the construction of a railroad across the isthmus of Panama. The construction of that road was begun on April 18, 1850, and ended on January 20, 1855. The building of the Panama road made unnecessary, for the time being, the construction of the Tehuantepec road, and this circumstance, in my opinion, more than anything else, has been in the way of building the Tehuantepec road.

The agitation produced by the treaties negotiated with the United

States about Tehuantepec, and the efforts of the parties to whom the Garay grant had been transferred to have it recognized by Mexico gave rise to a long and bitter discussion, with the result that the Mexican congress, on May 22, 1851, declared forfeited the charter granted to Don José de Garay on the ground that its conditions had not been fulfilled and that the last extension granted was not legal, as has been stated before.

But the Mexican congress, awake to the necessity of opening a means of communication, approved an act on May 14, 1852, requesting the executive to promote the organization of a company to undertake the building of the Tehuantepec road, on the basis therein set forth. Pursuant to that decree the executive branch of the government published, on July 29 of the same year, a notice inviting bids for the building of the road, and, after considering those that were presented, a contract was signed with Mr. A. G. Sloo and others, by which it was agreed that within a year from the date of the contract a plank road should be commenced, to be ended three years afterwards, and then succeeded by a railroad, which should be completed within the following four years. This contract was approved, with some amendments, by an act of the Mexican congress of February 5, 1853.

The same act of May 14, 1852, provided that negotiations with friendly powers should be opened with a view to make treaties which should recognize the neutrality of the passage through the isthmus, in case of war ; and by virtue of that provision a treaty was signed at the City of Mexico on March 21, 1853, between the Mexican plenipotentiaries and the United States minister, in which permission was granted to the United States government to guarantee the neutrality of the isthmus with armed force, when requested by the Mexican government, aud for the free passage of United States troops from one coast to the other. Special guarantees were given in the treaty to the contract of Mr. A. G. Sloo and company ; but, for the reasons already pointed out, the treaty was rejected by the Mexican congress, and in consequence of this fact, and on account of the construction of the Panama railroad having been commenced, the Sloo company could not fulfil their contract, and a decree of the President of Mexico, dated September 3, 1857, was issued declaring the forfeiture of the Sloo grant, for non-compliance with its provisions.

On September 7, 1857, the administration of General Comonfort, acting under extraordinary powers, granted to the Louisiana Tehuantepec Company, organized in New Orleans on July 30 preceding, a charter for the construction of the Tehuantepec route, making use of the Coatzacoalcos river as far as it could be made navigable, and the rest of the distance to be covered by rail. Work was to begin within

eighteen months after the date of the decree, the railway was to be built at the rate of ten Mexican leagues (about twenty-six miles) per year, and a carriage-road was to be opened at once. The latter was partially opened, and in this way a stage-coach line was established in 1858 and 1859, in connection with ships running between New Orleans and Minatitlan and between Ventosa and San Francisco, but passengers had to travel a short distance by horseback before reaching El Zuchil. The company agreed to pay Francisco P. Falconet $600,000 and interest, which had been deposited by the Sloo company with the Mexican government in accordance with Article IV. of their contract, and therefore the Louisiana company was in fact the successor of the Sloo company.

The grant of September 7, 1857, was liberally modified and amplified by another decree issued at Vera Cruz by President Juarez on March 28, 1859, and the extension of time then granted was again extended by another decree, issued also at Vera Cruz on October 25, 1860. But notwithstanding these liberal grants the Louisiana Tehuantepec Company could not even begin to build the road, and a decree issued at the City of Chihuahua by President Juarez on October 15, 1866, declared the forfeiture of the concession made to the Louisiana Tehuantepec Comany, owing to the non-fulfillment of its obligations, and granted it to the "Tehuantepec Transit Company," which also failed to fulfill its obligations, after which the charter was forfeited by a decree of August 26, 1867, issued at the City of Mexico.

The war of reform on the one hand, which lasted from 1857 to 1860, and the French intervention on the other, from 1861 to 1867, as well as the bad financial situation of the world, had prevented the building of the road, notwithstanding the several concessions successively made by the Mexican government; but it was believed that with peace restored to Mexico the principal drawbacks had disappeared, and on October 6, 1867, a concession was granted—also by virtue of extraordinary powers vested by congress in the president—to Emile La Sere, a native of New Orleans, or to a company that he might organize. This concession was modified by an act of the Mexican congress of January 2, 1869, which considerably amplified the privileges granted to Mr. La Sere or his company, and extended the time fixed for the completion of the work.

Another act of the Mexican congress, of December 14, 1870, renewed and extended the time agreed upon in that concession, to begin and finish the work, though the name of Emile La Sere was then omitted, and also authorized the company to construct a canal from the Gulf of Mexico to the Pacific. The time fixed to commence the work of construction expired on February 2, 1871, but on the 9th the

United States steamer *Nipsic* arrived at Minatitlan, carrying on board the engineers sent by the company under chief engineer I. J. Williams, and work was begun on that day. The Mexican government decided on January 24, 1871, that the work had been commenced within the time allowed, as the steamer had been delayed by stress of weather, for which the company was not responsible. An act passed by the Mexican congress on May 22, 1872, renewed the concessions of January 2, 1869, and December 14, 1870, and provided that the time for building the road should be counted from January 2, 1872.

A further act of the Mexican congress of January 15, 1874, extended for one year the time fixed in the grants of January 2, 1869, and December 14, 1870, to build the railroad and the canal at Tehuantepec. Another act of the Mexican congress of December 14, 1874, extended again for three and four years, respectively, the time agreed upon in the two above mentioned acts, and granted besides to the Tehuantepec Co. a subsidy of $7500 for each kilometer of road built. As the time, so often renewed, expired without any portion of the road being built, the Mexican government declared on May 31, 1879, the La Sere Tehuantepec grant to have been ended.

On January 19, 1878, a contract was signed at the City of Mexico, between the Secretary of Public Works and Mr. Hayden H. Hall, representing Mr. Edward Learned of New York city, for the construction of an interoceanic road at Tehuantepec, and on October 31, 1878, the contract was amended by common consent and submitted to congress for its approval, and was approved by an act of the Mexican congress of June 2, 1879, which gave a charter to Edward Learned, a citizen of the United States, or to the company that he might organize, to build the Tehuantepec road within three years and four months from the date of the charter, and granted a subsidy of $7500 for each kilometer of road built by the company and approved by the Mexican government.

This act was amended by another act of the Mexican congress of November 6, 1880, which authorized the Learned Company to build the road from the Coatzacoalcos river to Lake Superior (Laguna Superior) or over it or around it, as the survey should show to be more convenient.

It appears from official reports made to the Mexican government that the Learned Co. had completed in the year 1881, as follows: on February 17, 1881, five kilometers of road, on May 15, seven kilometers, on August 7, fifteen kilometers, and that the company had only thirty-five kilometers built when the grant was terminated.

On August 16, 1882, the Mexican government declared the forfeiture of the Learned grant, for non-compliance with its provisions,

and on December 20, 1882, Mr. George Tyng, representative of the Learned Co., signed a contract with the Secretary of Public Works at the City of Mexico, by which he conveyed to the Mexican government all the property, rights and materials of the Tehuantepec railway in consideration of $125,000, paid at once in Mexican silver dollars, and $1,500,000 payable in New York city in United States gold in installments, which was paid by me to Mr. William A. Booth, president of the company.

The fact that so many liberal grants had been made to various companies, and that none of them had been able to build the road, which was supposed to be a very profitable undertaking, made some believe that the Panama Railway Co. was at the bottom of the difficulty, and although this suspicion was in my opinion entirely groundless, and not shared by the government, it very likely contributed to decide public opinion to favor the idea that the government should undertake the work on its own account. Congress, therefore, authorized the executive on May 30, 1882, to undertake the construction, by the nation, of the Tehuantepec railway, or to contract for its construction with a company.

On June 30, 1882, the Mexican government appointed Don Delfin Sanchez, a gentleman who had some experience as a railroad builder in Mexico, for the purpose of buying all the material for the road, and soon afterward he was furnished with $600,000 to pay for the material to be ordered.

On October 5, 1882, a contract was signed by the Mexican government with Sr. Sanchez, as contractor for the construction of the road, on the basis of receiving $25,000 for each kilometer of road built, the road to be finished on February 28, 1885, and on the 11th of that month Sr. Sanchez acknowledged to have received from the Mexican government $701,000, on account of the contract; but the road was not built, and on April 25, 1888, the construction contract was abrogated, the Mexican government agreeing to pay Sr. Sanchez $562,910.50 as the value of the material and work done, and $170,224.90 representing the profits which the contractor would have to make if the work had been done.

By an act of December 14, 1878, the legislature of the state of Oaxaca authorized its governor to contract with the Federal government for the construction of the Tehuantepec railroad, in conjunction with the State of Vera Cruz or singly; and the legislature of Vera Cruz approved a similar act, as the isthmus of Tehuantepec occupies territory belonging to both states, but no action was taken under said acts.

By virtue of the authority conferred on the Mexican government by the act of congress of May 30, 1882, the President authorized

the issue in London, Berlin and Amsterdam, of a loan of £2,700,000, with 5 per cent. interest secured by the mortgage of the road. The bonds were sold to a syndicate of bankers at about 70 per cent., and on August 28, 1888, a contract was signed at the City of Mexico with the representative of Mr. Edward McMurdo, of London, for the construction of 226 kilometers of the Tehuantepec road and the repair of 108 kilometers which had been badly built, the work to be finished within thirty months, and the whole proceeds of the loan were placed at the contractor's disposal.

This contract was altered in some details by another contract signed at the City of Mexico on October 15, 1888, which was approved by an act of the Mexican congress of December 19, 1888.

Mr. McMurdo died in London before he could carry out his contracts, and his widow agreed with the Mexican government on January 13, 1892, to abrogate the contract under certain conditions specified therein and which were mutually accepted.

Congress again authorized the executive, by an act of December 18, 1891, to contract the construction of the road, and on February 27, 1892, a contract was signed at the City of Mexico with Messrs. Chandos S. Stanhope, an English subject, J. M. Hampson and E. L. Corthell, citizens of the United States, in which they agreed to finish the work if available funds were sufficient in fifteen months from the date of its commencement, and one additional month from the date of the contract was allowed to begin the work, and to secure the fulfillment of the contract the Mexican government placed at the disposal of the contractors $2,000,000, the balance of the proceeds of the £2,700,000 loan negotiated in Europe.

The net proceeds of that loan were not sufficient to finish the road, and soon after the expiration of the contract of February 27, 1892, a portion of another loan of £3,000,000 contracted at the City of Mexico, in November, 1893, was appropriated to that work, and on December 6, 1893, a further contract was signed at that city, with Mr. Charles S. Stanhope, for the construction of the fifty-nine kilometers of road unbuilt, which provided that the line shall be finished on September 6th of this year, with an additional expense of $1,111,035, and it is to be hoped that this last contract will be faithfully carried into effect, and that the road will be finished during the present year.

This account would not be complete if I failed to mention that the distinguished engineer, James B. Eads, conceived a project for building a railway capable of transporting ships from one ocean to the other, across the isthmus of Tehuantepec; and to that end he made, on April 16, 1881, a contract with the Mexican government, which was ratified by act of the Federal congress of May 28th of that year, and that

charter was modified and amplified by another contract signed at the City of Mexico with the representative of Captain Eads on May 2, 1885, which was also approved by the Mexican congress with certain alterations on December 15, 1885. In the first of these contracts it was stipulated that the work should be finished within twelve years from May 6, 1881, and that time was extended two years by the second contract. The Mexican government promised to pay the company as a guarantee, $18,750,000 at the rate of $1,250,000 a year, to be eventually refunded if the profits of the railway should exceed $3,750,000 per year, and in that case the sixth of that excess would be applied to the payment of the subsidy. The company was authorized to build a canal from Laguna Superior to the Pacific ocean, and it was further granted a subsidy of 168 square kilometers of land for every foot in depth of said canal. It was also granted 4200 square kilometers of land if it should deepen the Coatzacoalcos river to 25 feet.

Unfortunately, the extraordinary character of the project and the other difficulties to which I have alluded have not permitted the construction of this great work, but as a similar road is on the point of being completed on the isthmus of Chignecto, which connects the peninsula of Nova Scotia with the mainland in Canada, and will show the practicability of the work, it is likely that this fact will pave the way to the construction of a similar railway across the isthmus of Tehuantepec. The Chignecto ship-railway, which will connect the navigation of the Bay of Fundy with the Gulf of Saint Lawrence, is 17 miles in length and capable of carrying ships weighing 2000 tons. About three-fourths have already been built.

The grants above mentioned have led to the making of surveys of Tehuantepec several times. Besides the one made by Señor Moro, a United States Company in 1850 sent Major J. G. Barnard, U. S. A., as chief of engineers, to make a survey of the Tehuantepec isthmus, and although the condition of affairs which I have tried to sketch compelled the Mexican government to order the suspension of the survey, it had already been finished when Major Barnard was notified to leave the work, and its results were subsequently published.

In 1870, during the administration of General Grant, another and more complete and important survey was made, as he wished to ascertain which of the three American isthmuses was the most desirable for the construction of an interoceanic canal. He also appointed a commission of able engineers, which decided in favor of the route through Nicaragua. The surveying expedition sent to Tehuantepec under Capt. Shufeldt was accompanied by a corps of Mexican engineers, appointed by the Mexican government, under the lead of Señor Don Manuel Fernandez Leal, an eminent engineer, who holds now the position of Secretary

of Public Works. The Mexican commission made a thorough survey and its reports and maps were published in Volume III. of the Annals of the Department of Public Works of the Mexican Republic. The concession made to Captain Eads caused a more elaborate survey to be made, not only of the railway, but also of the terminal points of the road.

The Mexican government sent a delegate, Señor Don Francisco de Garay, to present the advantages of Tehuantepec at the International Congress on American Interoceanic Communications convened in 1879, at Paris, at the suggestion of M. Ferdinand de Lesseps, but he could hardly be heard because M. de Lesseps had decided in favor of Panama before the meeting of the conference, without taking into consideration the difficulties to be encountered. As M. de Lesseps was the promoter of the congress, it was composed largely of his friends, and he obtained a voto for Panama of 74 members, while only 14 voted against him and 7 refrained from voting. The Mexican delegate voted against Panama. Those who did not vote, and who represented that the matter had not been sufficiently discussed and that a majority of the members were not competent to decide the difficult technical questions, were Admiral Ammen and Señor Menocal, delegates from the United States, Señor Don Manuel M. de Peralta, delegate from Costa Rica, and now minister from that country to Washington, Señor Ordonez, delegate from Colombia, and others. M. La Valley, the distinguished French engineer who built the Suez canal, and who was a friend of M. de Lesseps, did not vote for Panama.

After so many efforts resulting in failure, the Tehuantepec road is now practically completed, and Mexico offers the result of all this work of many years, and great expense to the commercial interests of the world.

The comparative advantages of the Tehuantepec interoceanic route over the Panama route, in reference to geographical and commercial features are great. Any map showing the two routes will prove in a general way the geographical advantages of the Tehuantepec route in reference to the coast-wise commerce of the United States, and in a measure, its advantages in relation to the business of western Europe. Admiral, then Captain, Shufeldt, of the navy of the United States, in an official report made in 1871, thus forcibly expressed the commercial advantages of Tehuantepec: "Each isthmus rises into importance as it lies nearer to the center of American (United States) commercial interests." Other things being equal, the route which has the greatest advantages will lie nearest to what may be considered the axial line of the world's commerce, which may be drawn on the globe between Hongkong and Yokohama on the Asiatic coast across the Pacific ocean, through San Francisco, across the United States to New York, and across the Atlantic to Liverpool or Havre. Tehuantepec, of all the

interoceanic routes, lies nearest to this "axial line." In a direct line the distance is 1200 miles between Tehuantepec and Panama, or about as far as from New York to New Orleans.

Examination of a globe will show that shortest sail or steamer route from eastern Asia to any point on the Pacific coast of the American isthmus passes in close proximity to the shore line of Tehuantepec; in fact the shortest great circle from Panama to Hongkong will pass through Tehuantepec, east of San Francisco, and nearly up to the Aleutian islands. Even the shortest route from Panama to the Hawaiian islands will pass close to Tehuantepec. It will at once be apparent, therefore, that it will require almost a doubling of the above-mentioned distance to cross the isthmus at Panama, particularly for all traffic of the Pacific ocean seeking gulf ports. In a lesser degree the distance by way of Panama to all Atlantic ports of the United States and Eastern Europe will be largely increased over the Tehuantepec distance.

The following table of distance in statute miles between several ports has been compiled at the Hydrographic Office, Bureau of Navigation, of the Navy Department of the United States:

TERMINAL POINTS.	Via Tehuantepec Railroad.	Via Nicaragua Canal.	Via Panama Railroad.
New York to San Francisco	4,925	5,651	6,107
New York to Puget Sound	5,647	6,524	6,855
New York to Sitka	6,347	7,113	7,555
New York to Bering Strait	7,788	8,524	9,101
New York to Acapulco	2,722	3,507	3,988
New York to Mazatlan	3,476	4,232	4,675
New York to Hongkong	11,597	12,313	12,645
New York to Yokohama	9,984	10,626	11,211
New York to Melbourne	11,068	11,357	11,471
New York to Auckland	9,345	9,745	9,813
New York to Honolulu	6,566	7,390	7,705
New York to Callao	4,661	4,312	3,873
New York to Guayaquil	4,141	3,774	3,303
New York to Valparaiso	6,370	5,774	5,337
New Orleans to San Francisco	3,561	4,776	5,415
New Orleans to Acapulco	1,454	2,631	3,296
New Orleans to Mazatlan	2,027	3,357	3,983
New Orleans to Callao	3,393	3,436	3,181
New Orleans to Valparaiso	5,040	4,899	4,644
Liverpool to San Francisco	8,274	8,783	9,071
Liverpool to Acapulco	6,076	6,639	6,592
Liverpool to Mazatlan	6,714	7,364	7,640
Liverpool to Auckland	12,584	12,877	12,777
Liverpool to Guayaquil	7,379	6,848	6,267
Liverpool to Callao	7,899	7,444	6,837
Liverpool to Valparaiso	9,356	8,906	8,301
Liverpool to Honolulu	9,805	10,522	10,670
Liverpool to Yokohama	13,223	13,758	14,175
Liverpool to Melbourne	14,113	14,499	14,435

If a comparison is made with Tehuantepec on sixteen of the main routes of commerce between the east and the west, the total saving by Tehuantepec is over 125,000 miles. It will also be seen that the question of comparative distance also affects to an important degree the entire interior of the United States, particularly the Mississippi valley. It is only a little over 810 miles from the mouth of the Mississippi river to the eastern terminus of the Tehuantepec railroad. The total distance by rail and water from Chicago to the Pacific ocean via Tehuantepec is only 1875 miles.

The nautical conditions for sailing vessels are much more favorable at Tehuantepec than at Panama. Navigators always avoid, if possible, the region of calms on both sides of the Panama isthmus. These calms extend well into the Pacific ocean at Panama. Lieutenant Maury and Captain Bent, both acknowledged nautical experts, are my authority for this statement.

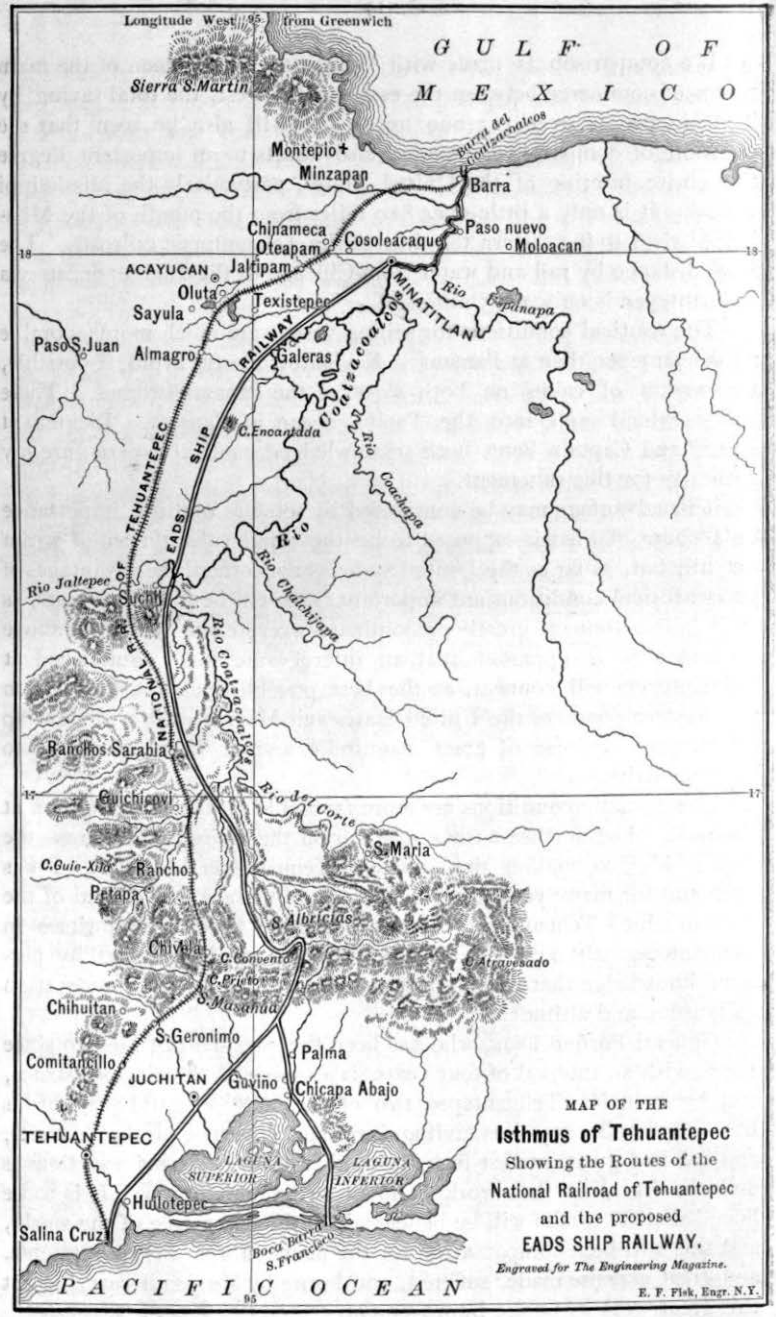
This advantage may be considered by some as of little importance on account of what is supposed to be the rapid substitution of steam for sail, but, as far as the United States is concerned, the advantages of good nautical conditions are important, and will be for many years, as their sailing tonnage greatly predominates over steam. From the above statement it is apparent that an interoceanic route established at Tehuantepec will connect, at the best possible location, the eastern and western coasts of the United States and Mexico, and will develop a coastwise business of great magnitude and of vast importance to both countries.

The climatic conditions are more favorable at Tehuantepec than at Panama. The northeast trade-winds from the United States cross the Gulf of Mexico, making the climate of Tehuantepec healthful. I was born and for many years lived at the city of Oaxaca, the capital of the state to which Tehuantepec belongs, and have been several times in Tehuantepec, although I never resided there, and I can assert by personal knowledge that it has a healthy climate, taking in consideration its latitude and altitude.

General Porfino Diaz, who has been the president of Mexico since 1877, with an interval of four years, is a native of the city of Oaxaca, and he spent in Tehuantepec two of the most eventful years of his life—1858 and 1859— as civil and military governor of that district, and has had great interest in building that road. To his exertions is due the fact that that work is now nearing completion. It is to be hoped that its results will be beneficial to the commerce of the world, and this will be a compensation for the many efforts, disappointments, and great expense made, suffered, and borne by Mexico in carrying out this great work of public improvement.

M. ROMERO.

Washington, March 10, 1894.


Longitude West 95 from Greenwich
GULF OF MEXICO
Sierra S.Martin
Barra del Tonalá
Montepio
Minzapan
Barra
Chinameca
Oteapam
Cosoleacaque
Paso nuevo
Moloacan
18
19
ACAYUCAN
Jaltipam
Oluta
Texistepec
Sayula
Rio Espinapa
MINATITLAN
Paso S.Juan
Almagro
Galeras
RAILWAY
Coatzacoalcos
C.Encantada
Rio Coachapa
TEHUANTEPEC
EADS SHIP
Rio
Rio Jaltepec
Suchil
Rio Chichihapa
NATIONAL R.R. OF
Rio Coatzacoalcos
Rancho Sarabia
Guichicovi
17
Rio del Corte
S.Maria
C.Guie-Xiña
Rancho
Petapa
S.Albricias
Chivela
C.Convento
C.Prieto
C.Atravesado
S.Musanda
Chihuitan
S.Geronimo
Palma
Comitancillo
JUCHITAN
Guiño
Chicapa Abajo
TEHUANTEPEC
LAGUNA SUPERIOR
LAGUNA INFERIOR
Hullotepec
Salina Cruz
Boca Barra S.Francisco
PACIFIC OCEAN
95
MAP OF THE
Isthmus of Tehuantepec
Showing the Routes of the
National Railroad of Tehuantepec
and the proposed
EADS SHIP RAILWAY.
Engraved for The Engineering Magazine.
E. F. Fisk, Engr. N.Y.

ADVANTAGES OF THE TEHUANTEPEC INTER-OCEANIC ROUTE.

By Elmer L. Corthell.

FIFTEEN years ago, upon the sea end of the East jetty, extending into the Gulf of Mexico at the mouth of the Mississippi, the man who had conceived and successfully executed this great work stood one day watching the passing ships. The bar, on which there had been only eight feet of water, had, at his command, yielded to the current forces and had gone out into the depths of the gulf, through a splendid navigable channel, sufficient for the largest ocean-vessels. Turning from these ships and looking out across the gulf he saw in imagination a low-lying land, 800 miles distant, and beyond it the waters of the great Pacific. Awaking as from a reverie he said to the writer: "We must next discharge the commercial volume of the Mississippi into the Pacific ocean." Then eight years of Captain Eads's life were given to the stupendous task of conceiving and executing the plans for this work, and of convincing the civilized world that ships could be taken overland from ocean to ocean. On his death-bed almost his last words were, "I cannot die; I have not finished my work." But his project did not die with him; it is waiting for another great genius and the proper time.

The other isthmian projects, which Captain Eads combatted and the failure of which he predicted, have come to grief already. It is not intended here to combat either of them, but simply to state the conditions, advantages, and entire feasibility of the Tehuantepec isthmus as a railway route, in the belief that the statement of the facts will be enough to prove the wisdom of President Diaz, of Mexico, in taxing the resources of his country to open here an interoceanic route.

Mr. M. Romero in the March number of the *Engineering Magazine* skillfully draws the outlines and fills in one corner of the picture—that part which relates to the efforts since the time of Cortes to find a pathway at Tehuantepec for the commerce of the world. The present writer proposes to fill in the remaining details and endeavor to make the picture complete and in harmony with that strong and growing sentiment of this and other countries demanding the best possible method of interchange of the world's products, across the American isthmus, and particularly of connecting the eastern and western coasts of the United States via the isthmus.

The table of distances presented by Mr. Romero is so complete

that the reader can by comparison see how much shorter is the Tehuantepec route as compared with other isthmian routes, but a study of the geographical features of this route, as well as of those around the southern extremity of South America, can best be made by means of the map of the western hemisphere accompanying Mr. Romero's article. By noting the trend of shores and continents he will discover that all lines leading from any point on the Pacific coast of the American isthmus by the shortest route to those countries lying along what Mr. Romero calls the "axial line of the world's commerce," will pass directly in front of the harbor at Tehuantepec. The delusive maps which in our childhood taught us the shape of the earth and the relations of the countries to each other would lead us to suppose that the shortest line between San Francisco and Yokohama or Hongkong is a line apparently parallel to the equator, whereas the shortest line, by nearly 500 miles, is the one that passes across the Pacific nearly up to the Aleutian islands near Bering straits. The trend of the entire Mexican and Central American coast on the Pacific follows quite closely the shortest great circle between Panama and Asiatic ports, so that the Tehuantepec port on the Pacific has the advantage of the entire distance between it and Panama,—over 1200 miles,—saying nothing of the additional advantage on the Atlantic side by being much nearer to the ports of the Gulf of Mexico, the Atlantic coast of the United States, and western Europe. Supplementing Mr. Romero's table there is given below the *excess* distance of Panama over Tehuantepec in statute miles, in respect to some of the principal ports to be affected by an interoceanic route:

New York and Hongkong	1048 miles.
New York and Auckland	468 miles.
New York and Melbourne	403 miles.
New York and Honolulu	1139 miles.
New York and San Francisco	1182 miles.
Liverpool and San Francisco	797 miles.
New Orleans and San Francisco	1854 miles.
New Orleans and Auckland	1445 miles.
New Orleans and Honolulu	1980 miles.

The *physical* conditions on the isthmus would require an entire paper to state them. There are doubtless many persons living who, early in the "fifties," under the impulse of the gold fever which took so many to California, made the trip by way of Tehuantepec. A company was organized to build a very good carriage-road (except in the rainy season) through the wilderness and across the plains between the head of navigation on the Coatzacoalcos river and Ventosa, the harbor for the Gulf of Tehuantepec on the Pacific. The pleasantest part of the route was between the gulf and Suchil, about seventy-five

miles, along the winding course of the great river Coatzacoalcos, which was navigated by the stern-wheel steamboat *Suchil*. This river for many miles is wide and deep, its banks covered with a luxuriant vegetation and many splendid varieties of forest trees. From Suchil for about thirty-five miles the traveled road at that time, and now the path, lies through a grand and primeval forest, with boughs so thickly interlaced that for miles the sun, even at noonday, is shut out. Here are some of the most valuable woods in the world—the dark mahogany of beautiful grain, the white mahogany, the Spanish cedar, and many other fine woods. The writer has often seen a half dozen large vessels at once loading at Minatitlan with mahogany and Spanish cedar for the United States and Europe. Only such of these woods as lie convenient to the navigable water-courses have been cut. Almost every kind of tropical fruit grows on the Atlantic slope of this isthmus, including bananas, plantains, oranges and lemons of the best varieties. There is no better country for coffee, tobacco, rice, and corn.

An interesting climatic feature is the sudden passing from the dense, exuberant vegetation of the Atlantic slope to the plains and the rolling pasture-lands of the Pacific. The climate, the soil, and the trees change entirely and almost instantly after passing the Jumuapa river. between the states of Vera Cruz and Oaxaca. From this point, towards the summit of the isthmus, the country is admirably adapted for grazing, and many great herds of cattle roam over these plains, everywhere so well watered by the mountain streams. After passing Chivela, which is at the head of a valley leading down to the Pacific, the Tehuantepec railroad now runs, through a cañon and the valley of the Verde to the Pacific plains, which for thirty miles are nearly level, with a sandy and clayey soil, with vegetation somewhat stunted, to the city of Tehuantepec on the left bank of the river of that name and thence for a few miles to Salina Cruz, the Pacific terminus of the railway. The rainfall on the isthmus is varied ; on the Pacific slope it is very light and on the Atlantic very heavy.

The accompanying general map of the isthmus shows the route of the projected ship-railway and that of the National railroad, the one starting from the mouth of the Coatzacoalcos river and the other from Minatitlan, about twenty miles up the river. These routes are not common except at one point, near Sarabia, where the railroad in its recent location goes through the pass found by the engineers of Captain Eads and since that time called the "Ship pass." Both have a common terminus at Salina Cruz, although it has been proposed to make a terminus for the ship-railway on the lower lagoon. The ship-railway route to Salina Cruz is 154 miles long, and that of the railroad 190 miles.

Perhaps at this time it will be of interest to describe the engineering features of the railroad, lately completed, in relation to which the efforts made by the Mexican government to furnish the necessary funds have been so fully outlined by Mr. Romero. A carefully written description is to be found in a paper by Mr. Manuel Rivera, C. E., one of the government inspectors on the railway. This paper was offered to the civil engineering division of the International Engineering Congress, at Chicago, but too late for presentation. Following is an abstract from this paper.

The line starts from the Bay of Salina Cruz, in the Gulf of Tehuantepec, on the Pacific, following the windings of a narrow ravine until it reaches the Zuleta pass, when it descends to Tehuantepec, a city of 15,000 inhabitants. Thence, in very easy lines, it passes across the Pacific plains to the foot of the ascent leading to the Chivela plains on the table-lands. Through the Chivela cañon the road is mostly built in solid rock. The lateral cañons, or ravines, are crossed by iron viaducts constructed by the Phenix Bridge Company, of Philadelphia. At Chivela the elevation is 790 feet above the sea-level, but there is a second summit to be overcome in crossing the Sierra de Niza Conejo (crazy rabbit), where the maximum summit is reached, 924 feet above sea-level. The maximum grade up to this point and in fact on the entire line is 2 per cent. and the curvature 200 meters (656 feet) radius, although in order to "join the rails" with as little loss of time as possible and with the least money there are temporary grades of 2 and even 3 per cent. and some few curves of 100 meters (328 feet) radius. The route across the table-lands lies through an ordinary rolling country, the maximum grade of the railroad being about 1.8 per cent. and maximum curvature about 600 feet radius. From the Jumuapa river the road passes through a dense forest for many miles to the Atlantic plains. The maximum grade on this slope is about 1.5 per cent. There are five large rivers to be bridged, the largest being the Jaltepec on the Atlantic slope, one of the chief tributaries of the Coatzacoalcos. The only tunnel on the line is about 300 feet in length. The material for the roadbed is generally good. The cross-ties and other timber were obtained from the United States, those for the Atlantic division coming from Pensacola or Mobile, and those for the Pacific slope from the red-wood forests of Oregon, but a large part of the iron-work was furnished by Great Britain. The rolling-stock is partly American and partly English. Sixty miles from the mouth of the Coatzacoalcos is found suitable limestone rock for harbor-works. At Coatzacoalcos there is a well-arranged and suitable terminal station and yard, the buildings for warehouses and shops being of iron, with corrugated roofs, manufactured in England.

There is no reason why, if some of the temporary sharp curves and grades are improved, which can be done at comparatively small expense, the road should not be operated economically and locomotives haul a train of twenty or twenty-five cars its entire length. The local business on the isthmus will be very considerable after the line is opened, as the richness of the soil and the variety of the products will lead rapidly to the development of the country. Besides the railroad telegraph there is a first-class telegraph line on iron poles across the isthmus—a link in the important cable lines of the Mexican and South American Telegraph Company.

In order to make the railroad valuable as an interoceanic route it will be necessary to improve the two harbors. The terminus on the gulf is at the mouth of the Coatzacoalcos river, which carries to sea for several months of the year a large volume of fresh water. Its watershed is about 6500 square miles. The rainfall is quite regular, in its seasons and in its amount, so that it may be depended upon to give a sufficient velocity for excavating and maintaining a deep channel through the bar in the gulf at the mouth of the river. About five miles below Minatitlan, on the opposite side of the river, the largest tributary, the Uspanapa, discharges into the main river. Below the mouth of this tributary at a point in the straight reach of the river, where the width is about 1000 feet between banks, the average maximum depth on the sections is about 70 feet and the cross sectional area about 40,000 square feet. The magnitude of this river will be appreciated by a comparison of its area of cross-section with that of the South Pass, Mississippi river, which is 24,000 square feet. It may be said that there is inside of the headlands at the mouth of the river a continuous harbor at least ten miles long. In the area immediately at the mouth, and which will be used for harbor purposes, the 30-foot channel is about 1000 feet wide and the 40-foot channel 850 feet. The shore on the left bank of the river at the terminal is nearly straight for about a mile. The river enters the gulf between two headlands, one composed of sand dunes and the other of solid land about 60 feet high. The persistent fresh-water flow excavates a deep channel through the bar at the mouth of the river.

As to the sea forces available for maintenance, their magnitude and constancy may be appreciated by their action on the outer slope of the bar, preventing its advance, although there is poured into the sea by the river during the rainy season, an immense amount of sedimentary matter. This outer slope, if measured on the line of the proposed channel and between the 18-foot and 44-foot curves is about 1 in 100, which is a steeper slope than that of any of the other large rivers along the coast of the Gulf of Mexico, except that of the South Pass

of the Mississippi as it existed before the jetties were built. These conditions are very favorable for economical construction and maintenance, since the combined action of the river and the sea, one behind and the other in front eroding the bar, greatly reduces the length of the works and the contents of the prism to be excavated by the currents. The plans proposed contemplate parallel jetties extending 4500 feet from the shore to about 24 feet depth in the gulf; the distance between the jetties to be 800 feet. The material in the permanent structure will be entirely of rock. As this harbor is to be used for a great interoceanic traffic, where the largest class of vessels will enter, a channel less in depth than that at New York or New Orleans should not be considered.

As to the maintenance of these works it is believed that jetties, constructed on the plans adopted—based upon an examination made by the writer of the jetties at the mouth of the Maes, in Holland, where there is at times a much more severe exposure to waves than at any point on the Gulf of Mexico—will be able to withstand the waves from the northers, which blow with great force across the gulf from the Texas coast and are quite persistent during the winter. As the question of the existence of wind or littoral currents for maintenance of the channel and the erosion of the outer slope of the bar is such an important one it should be stated that there is a pronounced and constant sea-current with a velocity of from one to three miles per hour entering the Gulf of Mexico between the peninsula of Yucatan and the island of Cuba; this current hugs the shore line all the way along the concave shore of the main land, past the mouth of the Coatzacoalcos river, Vera Cruz, and Tampico.

An observation of the existing physical conditions justifies the belief that there will be a recession rather than an advance of the bar at Coatzacoalcos. There is now upon this bar about 14½ feet of water, and the depth is well maintained and has little variation. From surveys made by Captain Shufeldt, U. S. N. (1871), by the writer (1881), and by Mr. Ripley (1892), there is shown to have been no advance of this bar into the sea for twenty-one years past. The sea and river forces have been in equilibrium, and the bar has decreased in width about 400 feet. Inside of the harbor it is intended to build a wharf, of creosoted timber and piles or of steel, 2000 feet long, parallel to the shore. The slope of the bank into deep water is so steep that this wharf need not be more than 100 feet wide from the shore line into deep water. It is intended to equip this wharf with the necessary tracks, warehouses, and a complete hydraulic plant for handling freight quickly and economically from the ship to the cars and vice versa.

On the Pacific the harbor works will consist mainly of a breakwater of broken stone coped with concrete blocks. Here the coast forms a succession of beautiful curves, whose arcs range from two to eight miles in length. Between each pair of curves a rocky promontory extends into the ocean. On the west of the curve at Salina Cruz, about three miles in length, the promontory is over 200 feet high and consists of hard durable rock, made up of quartzite, syenite, and porphyry. East of this promontory is a flat area of sandy formation with an elevation of about 15 feet above low water extending along the beach three miles to Ventosa. The sand of this formation is a coarse sharp grit of excellent quality for making concrete. The bottom of the bay seems to be of the same general character as the beach, no rock or clay having been found in the soundings. The slope of the shore under water is quite steep and deep water is therefore near at hand.

As the success of any improvement is largely dependent upon the action of the waves and currents it was gratifying to ascertain that the direction of the waves is almost normal, or at right angles, to the general direction of the coast, no matter from what direction the wind may blow, and that the current is always eastward along the shore. There is a constant surf upon the beach of sufficient magnitude to swamp any small boat except during the prevalence of one of the strong northers of winter, when but little surf exists. It will be necessary, therefore, to form a protected and quiet harbor. All freight must now be put ashore by small lighters, resulting in delay and in expense which is often as great as the entire freight-rate of sailing vessels between San Francisco and Liverpool around Cape Horn. To hope that vessels would lie at a pier in such a sea would be idle, and the expectation that any ordinary pier would stand such wave exposure would meet with early disappointment in the loss of the pier, even should the waves permit its construction.

It is estimated that the jetties and auxiliary works at Coatzacoalcos harbor will cost about $2,250,000, and the proposed terminal wharf and its equipment $360,000, the Salina Cruz breakwater $2,700,000, and the terminal piers and dredging $385,000, making a total for the harbors and terminals of $5,695,000 (gold). The contract for railroad work terminated in September. What it will cost to make the necessary betterments for interoceanic business in the way of reducing grades, improving curves, widening cuts, proper ballasting, equipment, and other expenses, it is difficult to estimate. Probably $2,000,000 would be sufficient to begin a good interoceanic traffic, so that the total estimated cost after September for the harbors and railroad, exclusive of interest during construction, would be about $8,000,000 in round numbers.

The commercial features give rise to questions that are of great moment and far-reaching. For fifteen years the writer has been chiefly interested, next to his engineering work, in the study of the relation of the American isthmus to interoceanic commerce. His investigation has been based upon the government statistics of commerce of the United States, Great Britain, and other countries, reports of maritime and other exchanges, and the United States consular reports from every quarter, in order to learn what are the products and the imports of each country, and by which routes these are transported. Special study has been given to the development of the commerce of the Suez canal, which has revolutionized the commerce of the globe. All of this has been done in order to arrive at an estimate of the commerce which would fall to the Tehuantepec route when opened.

A special investigation has been made at my request by an acknowledged commercial expert—Mr. Thomas J. Vivian, in charge of transportation statistics of the United States census—who undertook the task of answering, in the shape of a report, nineteen far-reaching questions. The method and the scope of this inquiry and the valuable facts gathered, alone would make a magazine article of great interest. The inquiry embraced the whole world. Commercial movements are in such delicate equilibrium that a disturbance of any kind, an improvement of a route or the opening of a new one, may affect the entire commerce and, with it, the industries of the world. Take the tea trade, for which the Suez canal and the transcontinental lines of the United States are contending. In 1884 49,964,482 pounds of tea reached the Atlantic coast of the United States from China via the Indian ocean, the Suez canal, the Mediterranean, and the Atlantic, while 18,256,764 pounds came across the Pacific, via the transcontinental lines to the country east of the Missouri river. But the San Francisco route is gaining. In 1890 the amount of tea received via Suez had decreased to 43,000,000 pounds, although the total amount handled had increased enormously. At the same time the amount handled by rail had increased to 39,000,000 pounds. It is necessary, therefore, to study the increase, as well as the general movements on the various routes of the entire traffic of the world.

The aggregate commerce of the five principal maritime nations—the United States, Great Britain, Germany, France, and Spain—increased 20 per cent. in the last decade, the annual increase averaging 2 per cent. Probably this rate would be diminished by including the returns from all other nations. It is safe to estimate the annual increase of the commerce of the whole world during the present decade at $1\frac{1}{10}$ per cent., at least, and this figure is used in the estimates which follow. From the sources mentioned tables have been compiled

showing the number and registered tonnage of vessels engaged in trade between the ports of twelve countries and the ports of twenty distinct countries on the Pacific and Indian oceans in 1890. Other tables show the commerce on still other routes. Analyses have been made of the amount of freight constituting the transcontinental traffic between the Pacific and points east of the Missouri river, with details of the freight carried from seaboard to seaboard; even the passenger traffic has been carefully investigated, that transported on certain routes in 1891 being compared with estimates of the percentage and number that would travel in 1896 via the Tehuantepec route, between Australia, Honolulu, China, and Japan to Europe; Pacific, Mexican and Central American ports to Europe; San Francisco to New York via Panama and vice versa, the westward movements, and other, though perhaps less important, travel between Cuba and China via New Orleans; passengers via the Suez canal and local passengers from all points on the western coast of Central and South America to points east of the isthmus on the Gulf and Atlantic. The time required for freight by various routes and the estimated time via Tehuantepec has been carefully investigated.

As an illustration of the importance of this examination take the following summary as between the representative terminii of New York and San Francisco, in which is given the actual time consumed in days and the distance in statute miles, equating the ocean and rail distance by multiplying the latter by 3; although if the equation is made on the basis of the real comparative cost 5 rather than 3 should be used.

Routes.	Number of Days.	Miles.
Around Cape Horn (by sail)	140	15,420
Via Straits Magellan (steam)	60	13,090
Via Transcontinental lines (fast freight)	25	10,203
Southern Pacific to New Orleans (rail). New Orleans to New York (steamship, fast freight)	14	9,386
Via Tehuantepec	20	4,280

One of the most important reasons for opening the Tehuantepec route will be seen by comparing the time and distance of the all-rail routes with the time and distance of the half-rail and half-ocean routes by way of New Orleans. In these simple figures lie the main reasons why the Southern Pacific and Morgan line route via New Orleans has been able to obtain from 75 to 90 per cent. of our entire transcontinental traffic. Now, if the fact that this route is one-half water has

given it such an immense advantage over the all-rail lines, may we not expect that, by carrying this principle further and uniting the two coasts by a practically all-water route on the shortest possible line, we may obtain some of the immense traffic between the Atlantic and Pacific coasts and interior of the United States? May we not further expect from the new and extraordinary facilities given to this country and particularly to the ports of the Gulf of Mexico we may develop an entirely new coastwise traffic between the southern and eastern coasts of the United States and Mexico and the Pacific?

Freight rates by all the various routes and of different classes of freight have been studied for the purpose of determining a reasonable charge for transportation via Tehuantepec. The highest and lowest freight-rates in 1891 on the eastern and western routes of the world for representative cargoes have been followed in great detail for the purpose of forming a reliable judgment. The varied questions of the present increase of traffic on all the main routes between the various countries and for various products have been investigated and these results applied to the proposed route at Tehuantepec. The estimate of the commerce that will be handled by the National Railroad of Tehuantepec has been based upon (1) the annual increase of the world's commerce, (2) the traffic of the season of 1890-91, and (3) the time fixed for opening up the route (1896). The traffic figures are based on freight tonnage, the rates being on the basis of the weight of commodities and not the registered tonnage of vessels. Instead of quoting a meridian of longitude as the boundary of the "attractive influence" of the Tehuantepec route, the actual reports of shippers and recognized facts, and the trend of commerce, have been taken to show the extent of this influence. It has been properly considered in the estimate that the saving in distance and time by the Tehuantepec route means that by a shorter route a larger number of voyages per annum can be made and consequently greater return to the vessel-owners on their investments and, in addition to this saving, an increase of annual earning capacity of vessels. By the use of the shorter route there would be the saving in the wear and tear of craft by avoiding the stormy routes by Cape of Good Hope and Cape Horn, also smaller cost of insurance and a general diminution of running expenses. It has also been taken into consideration that sailing-vessels could use this route, while it is impracticable for them to use the Suez canal on account of the impossibility of navigating the Red sea, or to use the Panama route on account of unfavorable nautical conditions in both oceans.

The writer contends that the great advantages—geographical, physical, nautical and commercial—of the Tehuantepec route over

Cape of Good Hope, Suez canal, Cape Horn, Straits of Magellan, Panama, Nicaragua and the transcontinental lines would enable it to divert to itself and create a combined aggregate tonnage of great magnitude, and that this route can successfully compete with any of those above mentioned, including Nicaragua, which is considered (erroneously in the opinion of the writer) to possess great special advantages. But the writer also knows that the Tehuantepec route must, in order to compete successfully, be fully equipped in extensive terminal and wharf facilities and be operated on the lowest possible grades permissible, with the easiest curvature, with a sufficient equipment of rolling-stock and in close connection with its own steamship line on the Pacific and the Atlantic, with harbors on both sides accessible to the largest ocean vessels under all conditions of weather.

On the above basis a summary of the detailed estimate shows that there may be reasonably expected in 1896 a total through traffic of 5,288,037 tons and that the gross receipts, with the addition of the passenger business and the local traffic on the isthmus from the adjacent and already rapidly-developing country, would amount to over $10,000,000 (gold).

The importance to the United States and to all other maritime nations to provide an interoceanic route, the approaches to which are favorable for sailing vessels, cannot be overestimated. Mr. Romero has given a brief comparison of nautical conditions at various points on the American isthmus which shows the impracticability of sailing vessels using the more southern routes on account of persistent calms and unfavorable winds in both oceans, and the entire practicability at Tehuantepec, on account of favorable winds. The world's tonnage that will be affected by an interoceanic route is larger in sail than in steam. In the fiscal year 1892–93 the fleet employed in trade between European and United States Atlantic ports and between Australasia and the Pacific coast was made up as follows:

	Steam.	Sail.
Register tonnage	2,535,202	3,958,891
Equal to cargo tonnage	3,250,000	6,400,000

In conclusion it should be stated that, by the wisdom and far-seeing policy and the persistent efforts of the president of the Mexican republic, not only the railroad, but the harbors, terminal facilities, and sufficient equipment, and all that is above outlined will be provided within the next three years. The opening of this interoceanic route for the benefit not only of Mexico but of the world is one of President Diaz's cherished objects. The question now is into whose

hands will this important route fall for operation and control.* Shall it pass to Europeans or to citizens of the United States? The country the citizens of which shall operate it will have for the next century a commercial advantage that cannot be overestimated. By whomsoever operated, this route is certain to effect a revolution more far-reaching and more important to the commerce and industry of the world than that which followed the construction of the Suez canal.

* This opinion of Mr. Corthell is not shared by Mexicans who believe their country which built the Tehuantepec railway ought to have exclusive control of it. M. R.