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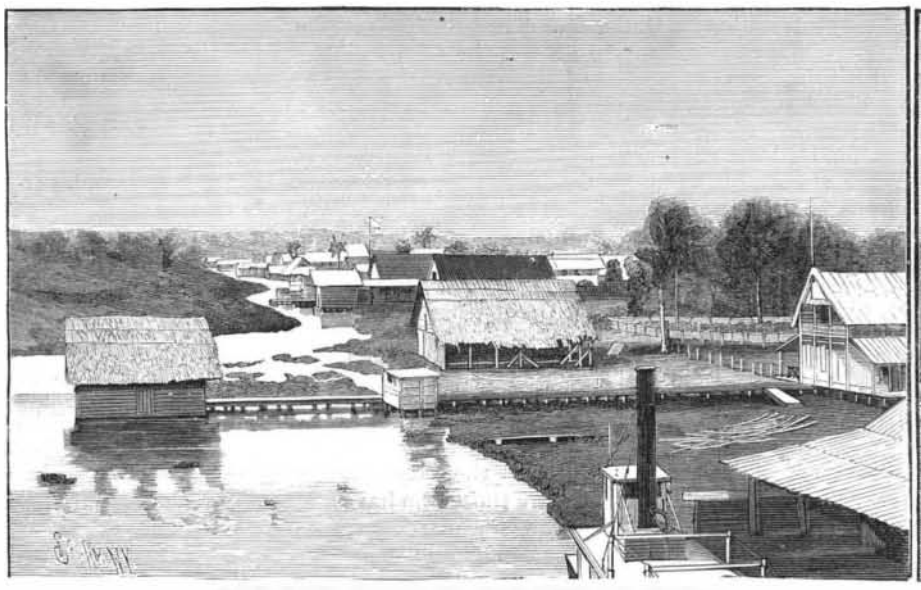
THE NICARAGUA SHIP CANAL.

Every discouraging report, for the past year or two, touching the probability of the completion of the Panama Canal, commenced by M. de Lesseps, has caused public attention to be yet more earnestly attracted to the Nicaragua Ship Canal project. The great difficulty and the enormous cost of the work thus far done at Panama has compelled those interested in the Nicaragua route to be extremely thorough and careful in their surveys and estimates, which have been completed with a detail that is in marked contrast with those previously made for the Panama Canal; and now that the plans for the latter have been changed to make it a lock canal instead of a tidewater cut, all the advantage that was ever claimed for the latter, as against the more northerly route, has been surrendered. When to this is added the fact that the financial state of the Panama Company now seems to have become desperate, it is obvious that the successful progress through Congress of the bill incorporating the Nicaragua Maritime Canal Company becomes a matter of the highest importance.

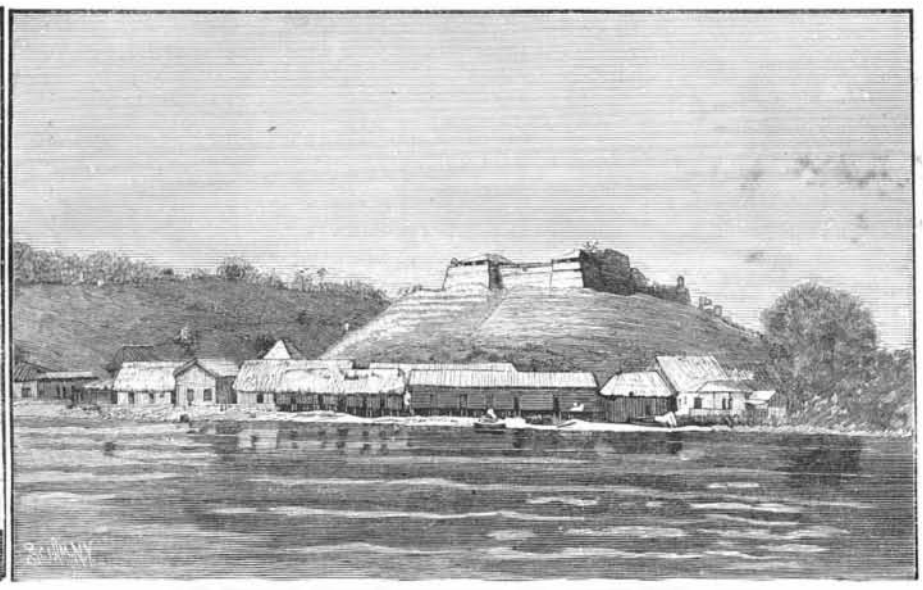
The bill incorporating the company was originally introduced more than a year ago, but was encumbered with so many amendments touching the amount of stocks and bonds the company might issue, and the manner of issuing them, and various other

(*Continued on page* 105.)

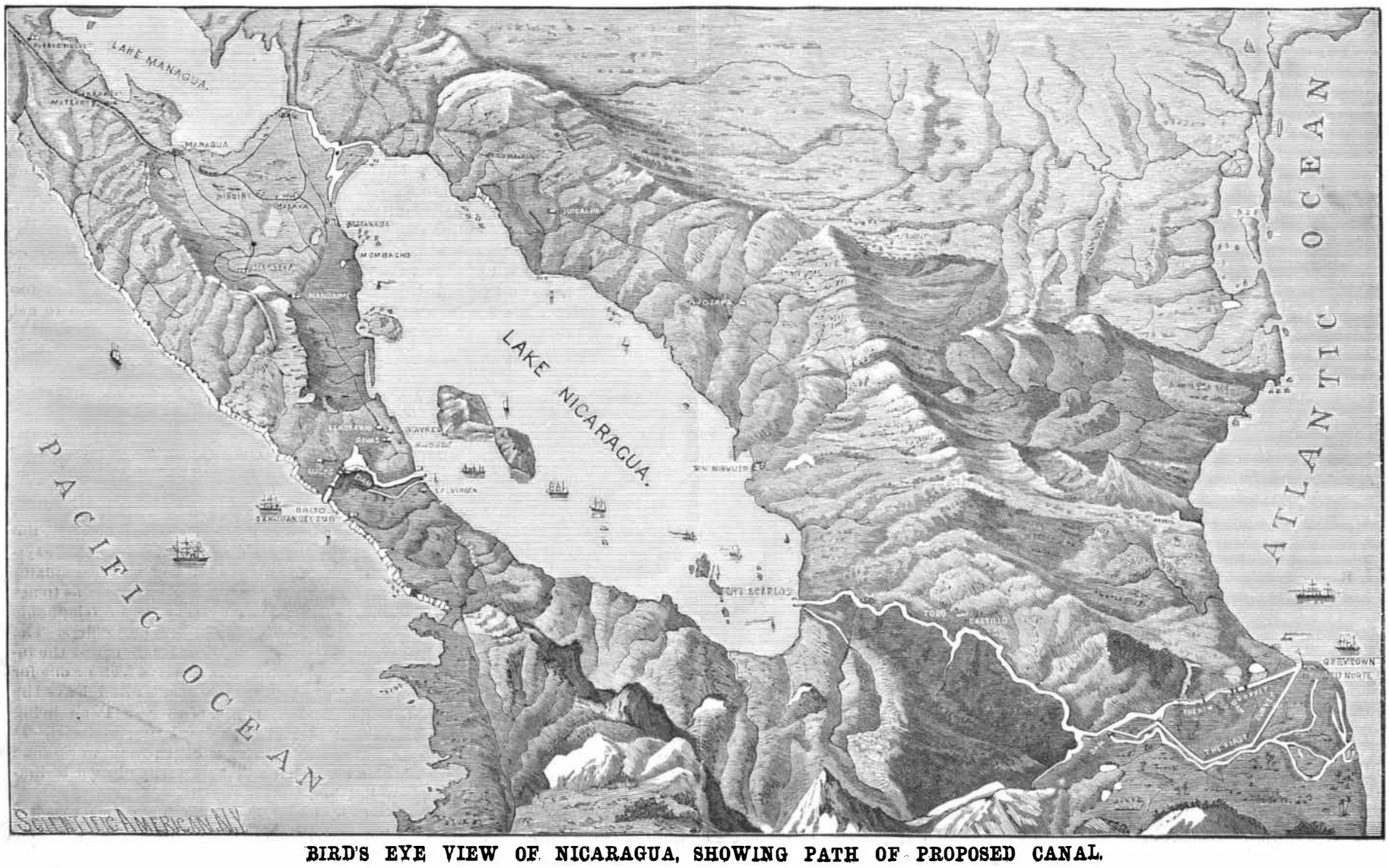
NATIVE HUT.



GREYTOWN, ATLANTIC TERMINUS OF CANAL.



OLD SPANISH FORT CASTILLO, ON RIVER SAN JUAN.



BIRD'S EYE VIEW OF NICARAGUA, SHOWING PATH OF PROPOSED CANAL.

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THE NICARAGUA SHIP CANAL.

(Continued from first page.)

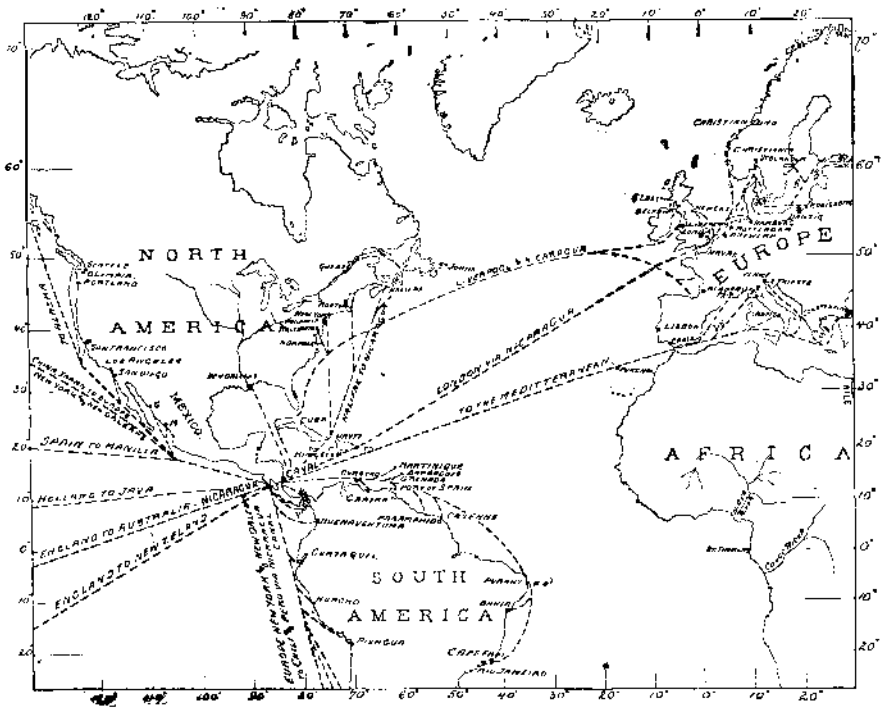
matters, that its passage has been delayed, the bill being finally sent to a conference committee of the two houses. The technical objections had been made mostly in the House, and these were largely receded from, the House adopting the report of the conference committee on the 6th inst., by the large majority of 177 to 60. On Feb. 7 the bill passed the Senate, and is now in the hands of the President, awaiting his signature. By its provisions the entire expense of the undertaking becomes a matter of private enterprise, and the investment of private capital, undertaken under concessions from the states of Nicaragua and Costa Rica, and in pursuance of treaties of those states with the United States.

The illustrations given herewith, with profile and bird's eye views of the route of the canal, and Central American views, graphically set forth the most important features of the undertaking. The total distance from ocean to ocean is 169·8 miles, of which 56½ miles is by lake, 84½ by river and basin navigation, leaving only 28·8 miles of actual canal. The summit level is at an elevation of 110 feet above the sea, the length of this level being 152 miles. There are six locks in all—three on the Atlantic and three on the Pacific side of Lake Nicaragua. The greatest cut through rock is three miles long, with an average depth of 120 feet.

This lake is deep and unobstructed, has a watershed of 8,000 square miles, and the San Juan River, through which the lake now has an outlet to the Caribbean Sea, is already navigable for light draught steamers throughout most of its length, requiring but little labor to deepen it. This river discharges at its lowest stage, near the close of the dry season, 984,096,000 cubic feet per day, or an amount of water more than eight times greater than it is computed will ever be needed for the lockages. From Greytown the sea level is carried 12 miles, to the site of the first lock, which has a lift of 31 feet, above which is a basin two miles long, formed by damming the lower waters of the Deseado River. At the end of this basin are locks 2 and 3, with lifts of 30 and 45 feet respectively, to the summit level, by which clear navigation will be afforded, as shown in the profile view, to within three miles of the Pacific coast. Locks 4 and 5 have a total lift of 85 feet, and lock 6 has a variable lift, depending on the state of the tide, which has a mean rise and fall on the Pacific side of about 6 feet. The size of each lock is 650 × 70 × 30 feet, thus allowing for the lockage of the largest vessels afloat, such as the Etruria, the Umbria, the City of New York, etc.

The canal will be, throughout, of a depth of 30 feet, while its least width, at bottom and top, in rock formations, will be 80 feet. In earth excavations the bottom width will be 120 feet and width at the top 180 feet, while in sand and loose material the bottom width will be 120 feet and the width at the top 360 feet.

Besides the construction of the locks, the leading engineering features of the work will be the construction of the two harbors, the one at Brito on the Pacific coast, and the other at Greytown on the Atlantic side, and the damming of the San Juan River for the purpose of raising and maintaining the level of Lake Nicaragua and the river for the long stretch at the summit level of 110 feet, with the formation of minor artificial basins at different levels, by means of dams and embankments. The harbor of Greytown was formerly open to vessels of considerable draught, but has almost been closed by sand bars; the surveys show, however, that the expense will be but moderate, by jettying with brush and pile, and finally strengthening of stone, of making an entrance for vessels of 30 feet draught to an amply protected and safe harbor, on which will be ample wharf facilities, and which will also be the terminus of a railroad to extend along the line of the canal. The harbor at Brito, on the Pacific coast, will require the construction of two break-waters, to give protection from the swell of the Pacific, while the harbor itself will have to be largely excavated, the excavation consisting of the deposits of the Rio Grande. The dam across the San Juan River will be 1,500 feet long by 65 feet high, backing up the waters of the river to a height 58 feet higher than they are now. By this means a lock and a large amount of dredging is saved, as compared with what was required by the earlier surveys. A further improvement of the later surveys is that on the Pacific side a dam will be made across the Rio Grande, 2,100 feet by 80 feet, by which the valley of the upper Rio Grande and the Tola will be flooded, leaving only a low continental divide of about 8½ miles to be cut through from the Tola basin to Lake Nicaragua, and a cut of three miles to the Pacific.



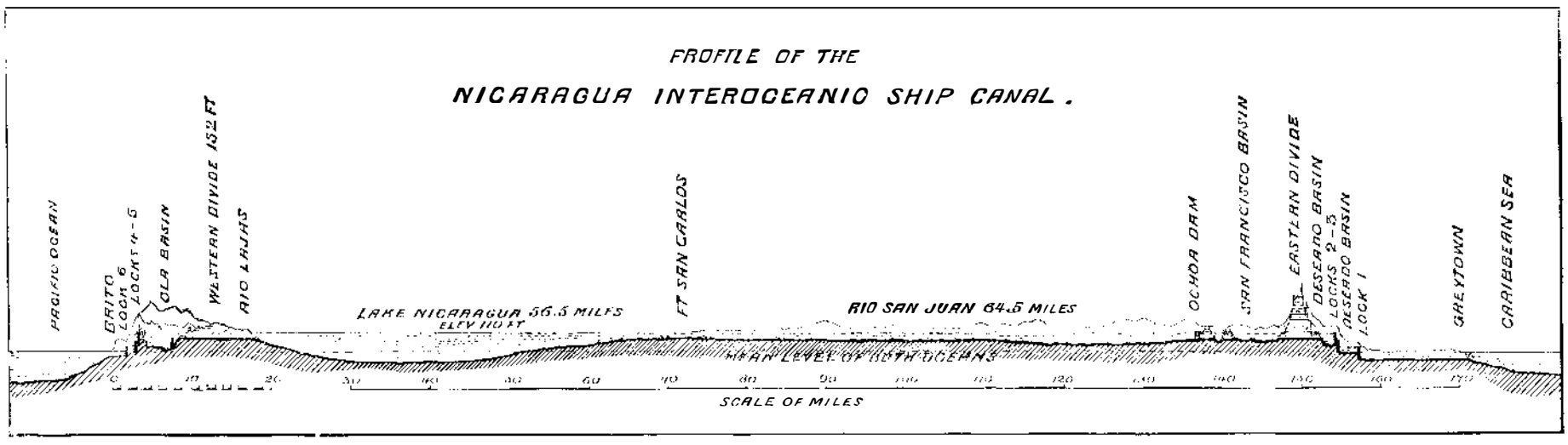
MAP SHOWING PROBABLE PATHS OF STEAMERS.

There have been several surveys for an interoceanic canal by way of Lake Nicaragua, the great length of free navigation afforded by that lake, its inexhaustible supply of water for lockage purposes, and the long stretches of the San Juan River which could be utilized to save excavation, with the comparatively low elevation of the back-bone ridges on either side, especially commending this location above all others. Chief Engineer A. G. Menocal, of the U. S. Navy, with Engineer R. E. Peary, as his principal assistant, and a numerous staff, made such a survey in 1885. Since then the present Nicaragua Canal Construction Co. has, under the general management of Commander H. C. Taylor, of the U S. Navy, been formed, and, in the latter part of 1887, sent out a well equipped expedition which has definitely located the canal and mapped out the line and its vicinity with engineering exactness. Careful borings were made along the whole distance, and the nature of the materials to be excavated are now clearly known, in kind as well as quantity. There is a long stretch of dredging back of Greytown and a deep rock cut at the divide on the east side, while on the west side the cutting is mostly through ordinary ground, with dredging and low ground excavation.

The estimated total cost of the work by the surveying expedition of 1885 was $50,000,000, and $15,000,000 for contingencies, or $65,000,000 in all. The later surveys practically confirm these estimates, and it is said that the whole work can be easily completed so that the canal will be open for navigation in 1895. These figures, it will be remembered, are the result not of one, but of several, very careful surveys, although they look surprisingly small by the side of the amounts already expended on the Panama Canal, for which that company's obligations to-day amount to over $400,000,000, with annual interest and fixed charges of about $22,000,000.

As to the climatic conditions under which work upon the canal will be carried on, it would seem that nothing could be more favorable, temperature tables for two years, taken near the head of the lake, showing a maximum of 93° and a minimum of 65°. For some ten miles back from the Atlantic coast the line will lie through swamps and lagoons, but here the work will be done mostly by machinery, and the climate in general is an equable and almost a temperate one. In the 49 engineers and 150 men in the employ of the company during the last survey, there was not a single cases of serious sickness, although most of the members were, from the nature of their occupation, almost daily exposed to constant wettings. The country is said to be rich in minerals, and cocoa, indigo, coffee, and fruit are the principal agricultural products. One of our illustrations gives a familiar picture of native life. There are but 45 whites and 5 negroes to every 1,000 of the population, the majority of whom are Indians of unmixed blood, the total population of Nicaragua being 250,000.

The effects upon the world's commerce, and upon that of the United States in particular, of the opening of the Nicaragua canal route is a matter in which even the most careful calculations are almost certain to be far below the reality. The canal itself will certainly have advantages over one at Panama, in being in a healthy climate, and in the heart of the northeast trade winds, where it offers especial convenience to all sailing craft, both in the Atlantic and Pacific. The trade between all our southern ports, especially, and those on the west coast of both North and South America, should be wonderfully stimulated, besides the large European traffic which the canal is certain to attract. It is calculated that on the basis of present commercial conditions there will be six to seven millions of tons of shipping annually ready and anxious to use the canal, and pay a revenue in tolls of $8,000,000, while the cost of maintenance of the canal, after building, is estimated at $1,000,000 annually. It will be at once seen that these figures, as to both the cost of construction and the probable revenue, render the outlook for the financial success of the undertaking extremely favorable



PROFILE SHOWING LOCKS, DAMS, AND DEPTH OF CUTTINGS.

Vaccination.

In Paris, where the law requiring vaccination is feebly enforced, the mortality from smallpox ranges from 136 to 10·1 to the 100,000 inhabitants, while in the principal German cities, where the vaccination laws are rigidly enforced, the death rate is but 1·44 to the 100,000 inhabitants. London, under compulsory vaccination, has a death rate from smallpox of but 0·6 to the 100,000 inhabitants. On the other hand, in the Canton of Zurich, in Switzerland, since the compulsory vaccination law was repealed in 1883, the death rate from smallpox has risen steadily from 8 to 85 to the 100,000 inhabitants.

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