A COMPARISON OF THE PANAMA AND NICARAGUA CANAL ROUTES.

In response to a large number of requests for a more complete treatment of the Isthmian Canal question than we have yet presented in the SCIENTIFIC AMERICAN we devote the current issue of the SUPPLEMENT entirely to this subject; moreover, on the front page of this issue of the SCIENTIFIC AMERICAN we present by map and diagram a condensed comparison showing the advantages of one route over the other. The SUPPLEMENT opens with two complete articles on the Panama and Nicaragua routes, which are based upon the reports of the International Commission on Panama and of the Nicaragua Canal Commission on the more northern route. In the same issue will be found an elaborate digest of the report, just issued, of the Isthmian Canal Commission. Our front page maps and diagram are based entirely upon the last-named report, which, by the way, is far the most complete and exhaustive document of the kind ever published, and will in all probability be accepted as a final statement of the case.

GENERAL DESCRIPTION.

The two canals have certain features in common. In both the greatest problem is the maintenance of the summit level and the control of the flood waters of rivers which are subject to extremely heavy freshets. In both cases the plan determined upon seeks to make the one difficulty cancel the other, the flood waters of the rainy season being stored by the erection of large dams across the course of the rivers, the dams being associated with spillways, or waste-weirs, by which the impounded waters may be regulated between predetermined maximum and minimum levels.

PANAMA.—The route of the Panama Canal extends from the six-fathom line in Colon Harbor on the Atlantic to the six-fathom line off Panama on the Pacific, a distance of 49 miles. The physical difficulties consist of the Culebra cut through the continental divide near the Pacific, and the floods of the Chagres River, which latter flows down from the northeast, intercepts the line of the canal at about its center, and coincides more or less with the general route of the canal from the point of interception to its Atlantic terminus. The problem is to be solved by cutting a tide-level canal for the first 16 miles from the Atlantic to Bohio, where a dam will be thrown across the Chagres River, the dam to be of sufficient height to form a great lake in the valley of the Chagres, whose maximum elevation will be 90 feet above mean sea level. Allowing for the greatest possible variation due to continued drought or to heavy freshets, the level of the lake will be maintained between the extremes of 82 feet as a minimum and 90 feet as a maximum level above the sea at mean tide. The surplus waters of the rainy season will be discharged over a weir 2,000 feet in length, which will be built not far from the Bohio dam, the waste waters being conducted to the Atlantic partly by the Chagres River and partly by artificial channel. At Bohio will be located a double-lift lock with a total maximum lift of 90 feet. The line of the canal traverses the Bohio lake thus formed for a distance of about 14 miles, or until it reaches Obispo, where there will be placed a set of gates 100 feet wide, the purpose of the gates being merely to retain the waters of Lake Bohio should it at any time be desirable to drain off the waters of that portion of the summit level lying beyond the gates. Passing through the gates the canal enters the Culebra section, which consists of a great cut through the continental divide. This section is about 8 miles in length, and at the Pacific end of it are the Pedro-Miguel locks. Then follows a level 1.33 miles in length, which leads to the Miraflores locks, by which descent is made to tide level on the Pacific. From the Miraflores locks to the 6-fathom line on the Pacific is a distance of 8.5 miles.

NICARAGUA.—Although the route of the Nicaragua Canal is nearly four times as long as that at Panama, the cost of its construction, while greater by about $6,000,000, is nothing like proportionate to its greater length. Topographically considered, the controlling features at Nicaragua are the existence of a great deep-water lake near the Pacific, and its connection with the Atlantic Ocean by the Rio Grande, a river of considerable size and discharging in the rainy season an enormous volume of water. Starting from Greytown on the Atlantic, the canal will be excavated generally along the edge of the delta formed by the San Juan River until it enters the river channel at a distance of 46 miles from the sea. Three miles further down the river, at Conchuda, it is proposed to build a great dam across the San Juan River, whose crest will be of sufficient height to raise the surface level of the impounded waters to a maximum elevation of 110 feet above mean sea level. The difference of level will be overcome by four locks at various points on this section. This dam will have the effect of canalizing the San Juan River from this point to its point of outflow from Lake Nicaragua, a distance of 49.64 miles. Where the sharper bends of the river occur, cutoffs will be made. The distance across Lake Nicaragua, 70.51 miles, will lie chiefly in deep water; but the approach to the canal at each side of the lake will have to be dredged to obtain the necessary depth of 35 feet. The remaining 17.34 miles of canal from the western shore of the lake to deep water on the Pacific will contain four locks, by which the difference of elevation of 110 feet will be overcome.

SUMMIT LEVEL.

PANAMA.—The average summit level proposed by the Isthmian Canal Commission for Panama is 85 feet above mean tide. This is to be secured by the construction of a dam at Bohio and a spillway nearby at Gigante, which will be a fixed weir 2,000 feet in length. Assuming a depth of 5 feet of water above the weir, this would provide for a discharge of 78,260 cubic feet per second, as against a maximum recorded flood of the Chagres River of 75,000 cubic feet per second. As a provision against seasons of extreme drought the canal will be excavated to such a depth that the summit level might fall to 82 feet and still leave the requisite depth of 35 feet throughout this section of the canal. The records of the Canal Company and of the Isthmian Canal Commission render it improbable that these extremes will be reached, or if reached, that it will be only at very rare intervals.

NICARAGUA.—The regulation of the summit level at Nicaragua is a much more serious problem, for the reason that it involves maintaining the level of the extensive Nicaragua Lake, which has an area of between 2,700 and 3,000 square miles, within certain predetermined maximum and minimum levels. It involves, says the report of the Commission, the control of the lake level within such limits "as will never permit the navigable depth of the summit level to be anywhere less than 35 feet on the one hand, nor permit the lake to rise materially beyond a determinate elevation on the other. This regulation can be accomplished by the construction of dams across the Rio Grande west of the lake and across the San Juan on the east side, both being designed with suitable wasteways for the discharge of surplus water." The minimum elevation has been fixed at 104 and the maximum at 110. The problem is a stupendous one, and limitations of space prevent any detailed discussion of it here.

DAMS.

PANAMA.—The Bohio dam is the most important structure on the line of the Panama Canal. The dam proposed by the Panama Company was to have been of clay founded upon a variety of material—hard clay, soft clay, sand, gravel, etc. The Isthmian Canal Commission very wisely decided that for a work of this importance security was a prime object to be aimed at. They decided that a masonry dam founded throughout on rock, or an earth dam with a masonry core going down everywhere to rock, would close the valley effectually and prevent all possibility of seepage. The core-wall-and-earth dam was preferred. The structure, which is to be 2,540 feet in length along its crest, will contain a core wall which will be carried down everywhere to rock, the latter being reached in places at a depth of 128 feet below the sea level. Below elevation — 30 the pneumatic process will be used in construction and above — 30 cofferdams will be used. The cost of this dam will be $6,369,640, and as it will probably take ten years to build, it will be the controlling feature in the question of time of construction of the canal. Once built, however, it will be a perfectly secure structure for all time.

NICARAGUA.—The dam designed by the Commission at Conchuda on the San Juan will be a smaller structure, and the greatest depth to rock will be only 80 feet. The regulation of the surface level will be accomplished by wasteways, vertically-moving gates of the Stoney type being adopted, each giving an opening of 30 feet on the crest of the dam. This discharge will amount to 100,000 cubic feet per second with the water in the pool immediately above it at 104. The total length of the dam, which will be entirely of masonry, will be 1,271 feet and its cost $4,000,000.

LOCKS.

PANAMA.—At Panama there will be but three locks in all, one set at Bohio, with a double lift of a maximum of 45 feet each and a total lift of 90 feet, and two sets at the Pacific end of the summit level—double-lift locks at the Pedro-Miguel and single-lift locks at Miraflores. All of these locks will be on a rock foundation.

NICARAGUA.—The ascent or descent from maximum summit level at Nicaragua will be accomplished by eight locks, four on the Pacific side and four on the Atlantic side.

LENGTH AND CURVATURE.

PANAMA.—The total length of Panama from ocean to ocean is 49 miles, and of this total 22.85 miles is curvature, the total degrees of curvature being 771. The curves are of very large radius and will present no difficulties in the way of navigation, a fact which is commented upon favorably by the Commission.

NICARAGUA.—The total length of Nicaragua from ocean to ocean is 186.5 miles, and of this 49.29 miles is in curvature, the total amount of curvature being 2,339 degrees. The greater part of this curvature occurs in the valley of the San Juan River, and owing to the limits imposed by the configuration of the valley, most of the curves are extremely sharp and must necessarily somewhat hamper navigation, particularly in the case of modern vessels of 600 or 700 feet length. An attempt is made to offset this by providing greater width in the canal on curves. There is no point, unless it be that of shortness in time of transit, in which Panama shows its great engineering and operating advantages over Nicaragua so much as in this matter of alignment.

HARBORS.

PANAMA.—The Panama Canal is greatly favored in the matter of harbors, which, by the way, are a most essential feature in the successful operation of a maritime canal. Good harbors exist both at Colon and Panama, and with the improvements suggested by the Commission they will be able to accommodate the largest shipping that seeks the canal.

NICARAGUA.—In the matter of terminal harbors, it must be confessed that the Nicaragua scheme is altogether wanting, since they simply do not exist. We publish in the current issue of the SUPPLEMENT two maps of Greytown Harbor, the Atlantic terminus of the canal, one map made in 1832, the other in 1895. In 1832 there was a spacious harbor with depths of from 18 to 30 feet of water. To-day three-fourths of this harbor is a sandy swamp, and the rest of it is a shallow lagoon with from 6 to 16 feet depth of water. An artificial harbor will have to be constructed both here and at Brito on the Pacific, and the cost of dredging to keep these harbors open will be a permanent charge upon the canal.

TIME OF TRANSIT.

It has been estimated by the Commission that a 400-foot ship would take 11 hours 14 minutes to pass through the Panama Canal, this estimate being based on a speed that varies from 7 miles an hour on curves to 10 miles an hour in Lake Bohio. It is estimated that the same vessel will take 33 hours to pass through the Nicaragua Canal. In the diagram on our front page, we have supposed that two identical passenger steamers of 18 knots sea speed enter the Atlantic termini at Panama and Nicaragua at 12 o'clock noon, January 1. By the time, 33 hours later, that the steamer at Nicaragua was at the Pacific, the steamer at Panama would be 378 knots distant on the Pacific. This gain, however, would be offset by the saving in distance and time between some of the ports on the Atlantic and on the Pacific.

WORK DONE.

The Commission estimates the value of the work done at Panama, the Panama Railroad, the maps, drawings, etc., at $40,000,000, while it states that "practically none of the property" representing work done, etc., at Nicaragua "would have any value to-day in the construction of the canal."

COST.

The total cost of completing Panama is estimated at $144,233,358, while the total cost of building Nicaragua will be $189,864,062. The Panama Company, however, have offered to sell their properties at the price named by our Commission, $40,000,000, thus making the cost of the completed Panama Canal $184,233,358. This renders the completed Panama Canal cheaper by $5,630,704 at first cost. The Commission, however, say it will cost $1,300,000 more every year to maintain and operate Nicaragua than it will Panama. This sum capitalized at four per cent and added to the cost of constructing Nicaragua, makes the Panama Canal, considered as a financial proposition, over $38,000,000 cheaper in the long run than the Nicaragua Canal.

The Current Supplement.

The current SUPPLEMENT, No. 1359, is devoted entirely to the subject of the Isthmian Canal controversy. It opens with an exhaustive article on each canal, both of which are elaborately illustrated with maps and profiles, and with photographic views taken along the route of the canals. These articles are followed by an elaborate digest of the recently published report of the Isthmian Canal Commission. The whole number forms a complete compendium of information upon this great topic. There are some 40 illustrations in all.

The Lancashire and Yorkshire Railway of England has introduced an electric motor engine for shunting purposes on its sidings at Manchester. This locomotive has been specially constructed for the purpose, and has a hauling capacity of 120 tons. It is anticipated that a great saving in working expenses will be effected by this employment of electric traction in preference to steam, while the scheme possesses the additional advantage of being less noisy, and creates no nuisance with the smoke.

PANAMA OR NICARAGUA—WHICH?

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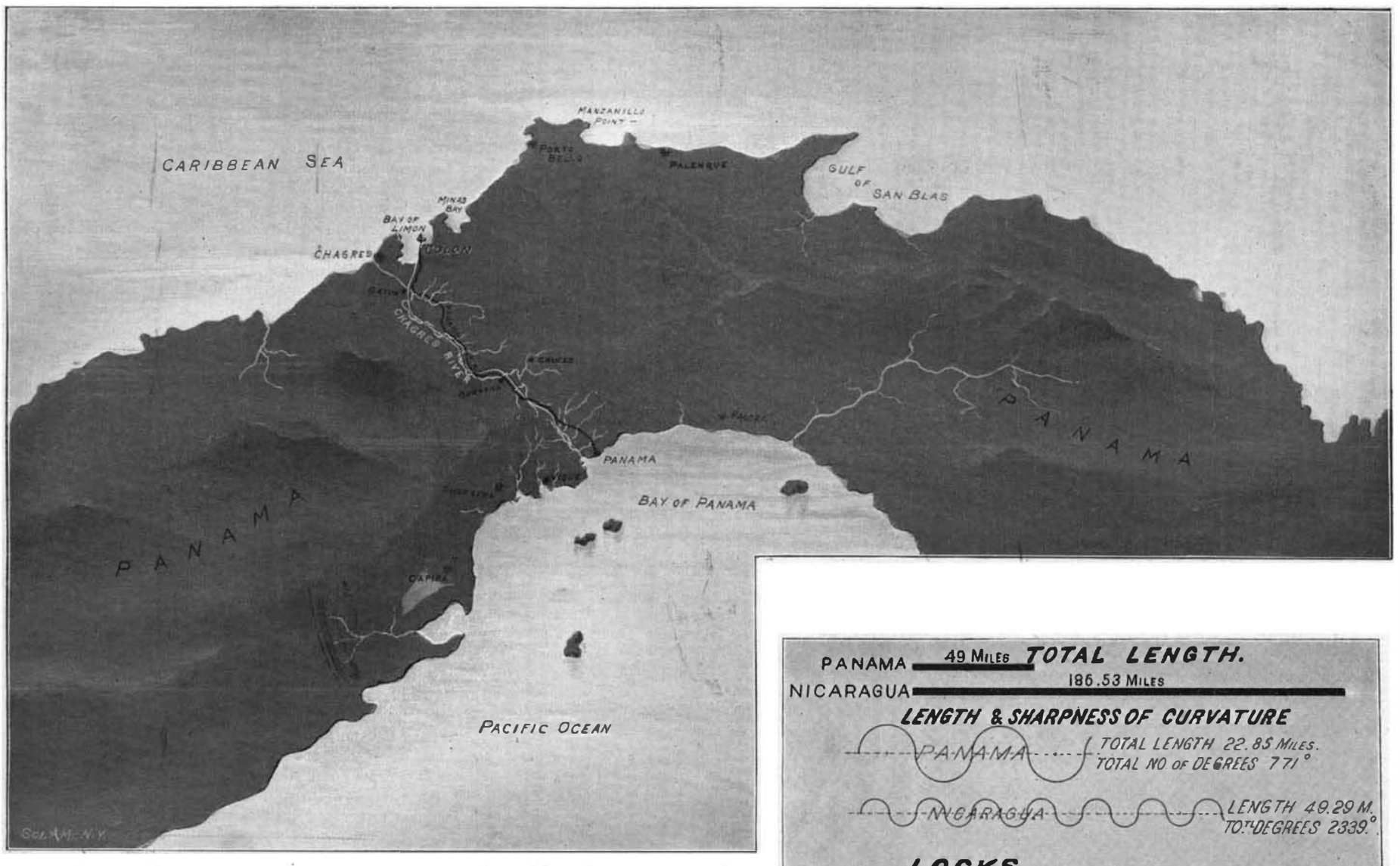
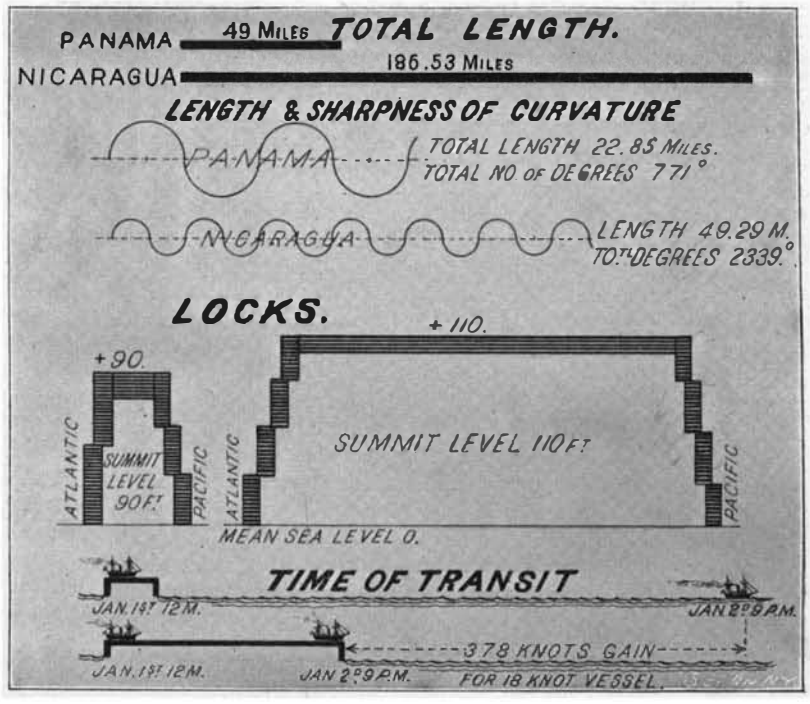
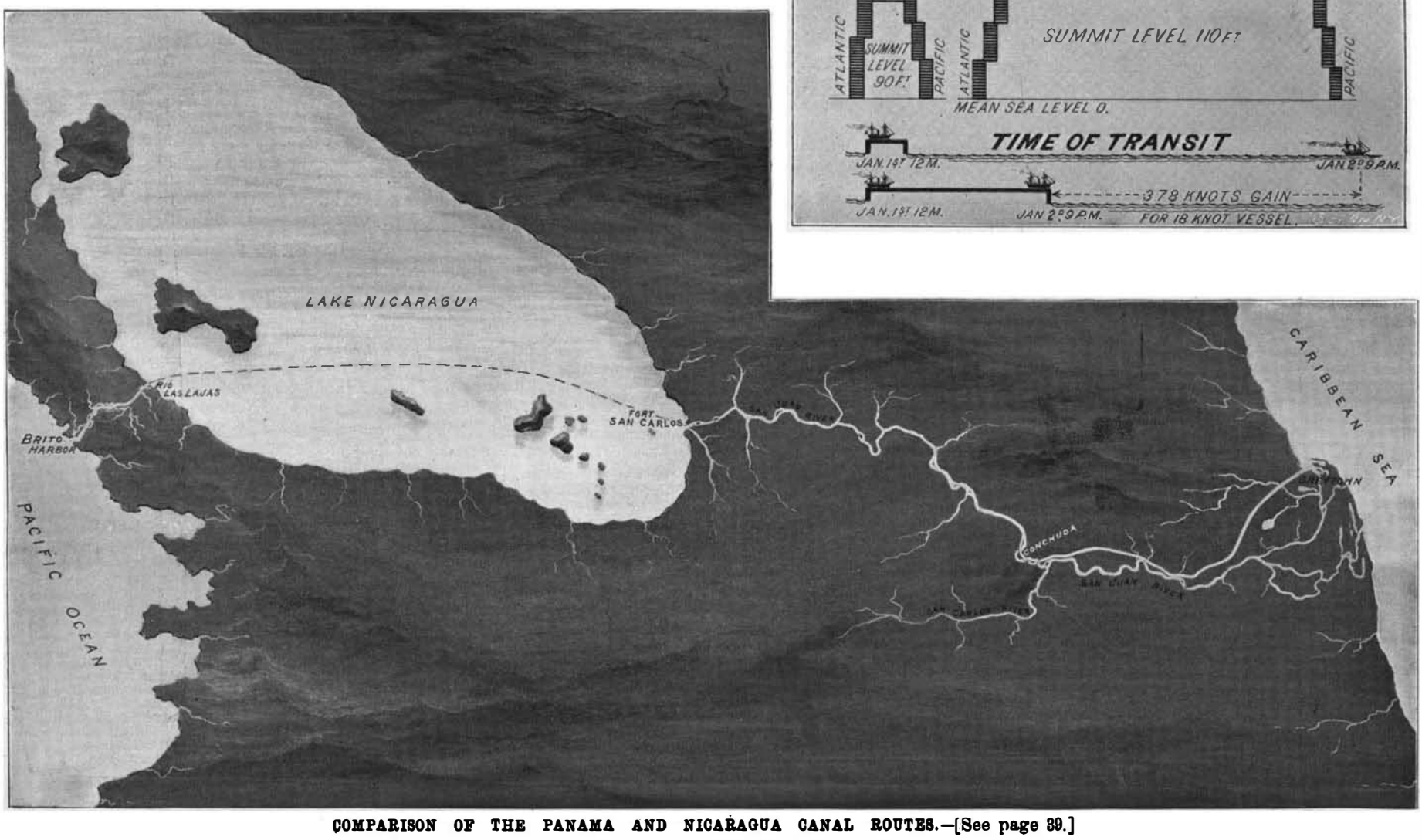


Panama Canal—Length, 49 Miles. Time of Transit, 11 Hours 14 Minutes.





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