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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE ISTHMIAN CANAL—HISTORICAL.

NICARAGUA.—The first actual survey for a canal at Nicaragua was made by an American, Col. A. W. Childs, in 1850 to 1852 The project as outlined by him has been the basis for all subsequent locations; the route selected in his survey differing indeed but very little from that which is now recommended by the Isthmian Canal Commission. Childs recommended a summit level, in which was included Lake Nicaragua, 108 feet above sea level, this level to be reached by twelve locks on the eastern side and thirteen locks on the western side. The canal was to have a depth of 17 feet and a bottom width of 50 feet, and the total cost was to be $31,538,319. Then followed a survey in 1872 under Commander E. P. Lull, U. S. N., in which the lake was to be held at a minimum summit level of 107 feet, reached by eleven locks on the western and by ten locks on the eastern side of the summit. The depth of the canal was to be 36 feet and the cost was estimated at $65,722,137. Eleven years later another survey was made, this time by A. G. Menocal, Civil Engineer, U. S. N., the object of the survey being the relocation of the Lull survey with a view to cheapening the cost. The principal changes consisted of the creation of a summit level, which extended from a dam in the river west of Lake Nicaragua to a dam some 65 miles down the San Juan River from the lake. The canal was to leave the San Juan just above this dam and be carried by a short cut through the hills to the Caribbean Sea. The Maritime Canal Company was formed in 1889 to construct a canal on the lines of the Menocal survey. The total estimate for this canal with a 28-foot depth of water was $67,000,000. After doing more or less work the Maritime Company ceased operations in 1893 for lack of funds. In 1895 Congress appointed the Ludlow Commission to examine and report on the Maritime Canal Company's project. This Commission reported that the difficulties of building the canal had been underestimated; and they submitted an estimate of their own which placed the cost of completion at $133,472,893. At the same time the Board suggested a more thorough examination of the locality. In response to this recommendation the Admiral Walker Commission was appointed; and in due course it reported that the canal would cost a maximum sum of $140,000,000. It was about this time that the government awoke tardily to the realization of the fact that the canal question was a wider one than that of Nicaragua alone, and a new board, known as the Isthmian Canal Commission, was appointed to investigate every possible route across the Isthmus and definitely determine which was the best. A digest of this report will be found elsewhere in this issue, and in more extended form in the current issue of the SUPPLEMENT.

PANAMA.—It will be a surprise to many who believe that American interests are necessarily and exclusively identified with Nicaragua to know that the Panama route was surveyed by Commander Lull in 1875, that he recommended the construction of a 26-foot canal with a summit level of 124 feet above mean tide level, and that this route was located very much on the same route as that adopted by the present Isthmian Canal Commission. He estimated the cost of this canal at $94,511,360. In 1879 an International Congress met in Paris and recommended the building of a sea-level canal from Colon on the Atlantic to Panama on the Pacific, the work to be completed in twelve years at a cost of $240,000,000. Work was begun in 1881. An enormous amount of plant was purchased, 15,000 laborers were imported, and with the most incomplete data to work upon, the De Lesseps people rushed into the most stupendous engineering undertaking of the age. Yellow fever, floods, incompetence, unparalleled fraud and dishonesty, coupled with the impossible nature of the undertaking itself, soon brought about the inevitable disaster, and in 1889 a receiver was appointed, who found that securities to the amount of $435,000,000 had been issued and $246,000,000 had been squandered. In 1894 a new company was formed for the purpose of completing the canal. They determined to abandon the scheme for a tide-level canal and, instead, adopted a plan for a canal 29½ feet deep with a summit level of 97 feet, a second level of 68 feet and a third of 33 feet above the sea. The Chagres River was to be controlled by means of a dam at Bohio, forming a navigable lake in the valley of the Chagres, and another dam further up the Chagres River, which was to supply water to the summit level. An International Technical Commission of Engineers examined the plans of the new company and pronounced them perfectly feasible, the estimated cost of completing the canal being set down at $102,400,000. Our own Isthmian Canal Commission propose a 35-foot canal, with a 90-foot summit level and three locks, which they estimate can be built for $144,233,358. The latest step of importance connected with the canal has been the offer of the Panama Company to sell its property for the sum of $40,000,000.

THE CANAL FROM THE ENGINEERING STANDPOINT.

The report of the Isthmian Canal Commission has swept away from the whole canal question a mass of misconceptions and misstatements with which it has been hitherto clouded. After a careful perusal of the report one is impressed with the conviction that the physical obstacles to the construction of a canal either at Nicaragua or Panama have been mastered; that the uncertainties have in a large measure disappeared; and that, judged from the standpoint of construction and subsequent maintenance and operation, Panama offers decidedly the better route.

1. In the first place, the Panama region is much better known and understood; the observations extend over a longer period; the surveys have been considerably more elaborate and complete; the climatic conditions are better known; and work having been opened up along the whole route and prosecuted with more or less energy for twenty years, the nature of the soil, its action when exposed to the weather, and in the process of handling is, by this time, well understood.

2. At Panama there is a well-built railroad throughout the whole length of the canal, terminating on each ocean in a good harbor with ample wharf and dockage facilities. Should the United States determine to build this canal, contractors could go down and commence work at once, for good housing accommodation is already on the ground for an army of from 15,000 to 20,000 laborers. At Nicaragua, on the other hand, entirely two new harbors would have to be created, at a cost of $3,750,000, and 100 miles of double-track railroad would have to be constructed at a total cost of $7,575,000. In fact, two years' time and $11,000,000 of money must be expended before the actual construction of the canal itself could be commenced on any adequate scale.

3. At Nicaragua the work would be spread out over 183 miles of distance, whereas at Panama it would be concentrated within a distance of 49 miles—a fact which would conduce greatly to facility and economy of construction.

4. At Panama the plan of control of the flood waters and of maintenance of the summit level is very much simpler than at Nicaragua. At Nicaragua a 3,000-square-mile lake and 60 miles of canalized river have to be maintained at a predetermined level, alike in periods of drought and heavy rainfall; while a flow of 200,000 feet per second of water has to be controlled in the San Juan and San Carlos Rivers. At Panama, on the other hand, the problem involves the control of a single river, with a maximum flow of 75,000 cubic feet per second, and by the erection of a single dam the flood waters of this river are conserved in a summit lake, the conditions of whose regulation are accurately determined. At Panama the problem is relatively far less stupendous, and the engineering and general hydraulic data are better known.

5. At Nicaragua there is a 110-foot summit and seven different levels, involving the construction and operation of eight widely separated locks, whereas at Panama there are but two levels and three sets of locks, and the summit level is 20 feet lower.

6. The total length of the Nicaragua Canal is nearly four times that at Panama, and the time of transit is longer by about 22 hours, the respective periods being 33 hours for Nicaragua and 11 hours 14 minutes for Panama, and although this difference is offset in the case of voyages between certain ports by the fact that the distance from port to port by Nicaragua is less than it is by Panama, it must be remembered that a ship when sailing in deep water is undergoing fewer risks than when she is navigating a tortuous and shallow artificial canal.

7. The risks of operation are considerably less at Panama, for the reason that vessels will spend far less time within what might be called the "danger zone," this last being that portion of the canal which is above tide level. The danger zone at Nicaragua will be 176 miles in length; at Panama, on the other hand, it will extend for only 23½ miles. This is a most important consideration for vessels of the merchant marine, and it has an even more important bearing upon the interests of the navy.

8. Finally, while the time for the completion of the two canals is the same, the cost of Nicaragua, now that the Panama Company has offered to sell its properties for $40,000,000, is $5,630,700 greater. To this must be added the fact that a canal at Nicaragua would cost $1,300,000 more every year to maintain and operate.

THE CANAL FROM THE STANDPOINT OF COMMON SENSE.

The great Isthmian Canal problem has reached a stage at which it needs only the exercise of a little common sense for its satisfactory solution. The question of the proper location for the canal is first and last one of engineering. In considering it, the American people should remember that whatever of sentiment, whatever of prejudice, whatever of so-called patriotism or national prestige has been allowed to entangle itself in this question, ought to be entirely swept away, and the problem looked into, weighed, judged and a final decision reached purely on the physical and engineering facts as they have been determined by our government engineers and presented to the American people for their decision in the recent most able, comprehensive and easily understood report.

We have no hesitation in saying that if anyone who is interested in the Isthmian Canal problem will read the digests and analysis of this report as presented in the current issues of the SCIENTIFIC AMERICAN and SUPPLEMENT, he will come to the conclusion that judged on the grounds of practicability of construction, security, permanence, convenience and ease of operation, and cheapness of first cost and maintenance, the Panama Canal as designed by our engineers is by far the better scheme. Having said this one has said all; but if it be suggested, as has lately been frequently done, that Nicaragua has exclusive claim upon our national interest and sympathy, it must be replied that the first complete survey at Panama was made, as we have shown elsewhere, by an American naval officer for the American government, and that over half a century ago this country concluded a treaty with New Granada (now the United States of Colombia) guaranteeing the perfect neutrality of the Isthmus at Panama as a highway from the Atlantic to the Pacific. The solemn stipulations of that treaty have remained in force ever since, and only within the last few months our government, acting under the stipulations of this treaty, landed troops for the protection of the Panama Railroad.

Congress has grown so used to considering Panama as a French undertaking, that it is only now beginning to realize that if we take hold of the Panama scheme under our own terms of purchase, it becomes as truly an American enterprise as would the construction *de novo* of a canal at Nicaragua.

Although the Hepburn Canal Bill has been passed in the House by a practically unanimous vote, it is significant that an amendment authorizing the President to negotiate for the Panama as well as the Nicaragua route was lost by 102 votes to 170. This result would indicate that if the Senate should send the bill back to the House, amended so as to provide for building the canal on the Panama route, the House would accept the revision.

THE NEW YORK CENTRAL TUNNEL TRAGEDY.

The Park Avenue four-track tunnel of the New York Central and Hudson River Railroad is altogether unique among the celebrated tunnels of the world. It brings the traffic of two of the greatest railroad systems in America into the most crowded station yard and station in existence. The multiplied traffic of the New York Central, the Harlem and the New Haven Railroads converges to this tunnel at its northern end, where the ten tracks of these three systems unite in four tracks, and the accumulated traffic, acting like flood waters suddenly confined within a narrow channel, literally surges and struggles—we had almost said eddies—stopping, starting, crowding train upon train, until it is liberated at the southern end of the tunnel, and spreads out again like liberated flood waters onto the many tracks of the yard and terminal station. In view of the fact that the smoke and steam and dust of the many trains that rush through render the visibility of signals at the best of times somewhat uncertain, the dictates of prudence and safety would suggest that the whole length of this tunnel, about a mile and three-quarters, be treated as a complete block in the automatic block signal system of the road, no two trains being allowed on the same track within the tunnel at the same time. This course, however, though eminently safe, would be quite fatal to that dispatch in handling the traffic which the traveling public is ever demanding of the railroads that run into this station. Consequently the railway company has divided the tunnel itself into signal blocks with distance and home signals, and by using the best-known automatic devices, has endeavored to effect a compromise between safety and dispatch, sacrificing something of the