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THE PRESENT ASPECTS OF THE PANAMA CANAL FROM THE TOURIST'S POINT OF VIEW.

BY

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THE idea of a canal is almost as old as the discovery of the Isthmus. It is said that in the year 1620 one Diego de Mercado submitted a report on the subject to Philip II, but the King of Spain replied that the will of God was made manifest when he created an isthmus instead of a strait, and it would be impiety for man to attempt to unite the waters of two oceans which God had separated. The project was declared sacrilegious, with the usual penalties, and the matter was dropped.

In the early part of the Nineteenth Century attention was again directed to the Isthmus and various surveys were made by the United States Government and others. Finally, in 1879, Count Ferdinand de Lesseps formed a company and began the work of digging the canal. The original intention of de Lesseps was to make it a sea level canal, but as it was found impossible to complete such a canal within any reasonable time the lock type was adopted. The company finally went into liquidation and a new one was formed which also eventually came to grief for want of funds. It is unnecessary to dwell at length upon the events which led up to the acquisition of the property rights and privileges of the French Canal Company by the United States.

The people of Panama had never been satisfied with their relations with the Bogota Government and had made, from time to time, attempts at separation, some of them resulting in much bloodshed, but none of them successful. The failure of the Hay-Herran Treaty in 1903 resulted in conditions which seemed to give them an opportunity of which they promptly took advan-

tage. The result was that the United States got a concession from the new Panama Republic under the terms of which it was possible to build the canal. It is very doubtful whether the canal could be completed under conditions less liberal than those granted by the Republic of Panama.

THE CANAL.

The Panama Canal is about 51 miles long from deep water on the Atlantic side to deep water on the Pacific side, but as the distance from deep water to the shore line in Limon Bay, in the Caribbean Sea, the Atlantic side, is about $4\frac{1}{2}$ miles and from the shore line to deep water at La Boca, the Pacific side, is about 5 miles, the canal proper, from shore to shore, will be about 41 miles. From Limon Bay to Gatun locks and dam it will be a tide-water canal for 4 miles. The tide at Limon raises about 18 inches. From Gatun to Pedro Miguel, 32 miles, it will have a summit elevation of 85 feet above the sea. From Pedro Miguel to Miraflores, about 2 miles, it will have a summit elevation of 55 feet, and from Miraflores to La Boca, on the Pacific Side, it will be a tide-water canal. The tide on the Pacific side is from 18 to 22 feet. The bottom width of the canal in its narrowest part, Culebra cut, will be 300 feet, with an indefinite width in the deep waters of the Gatun Lake. On both ends of the canal, from deep water to land, the channels will be 500 to 1,000 feet wide and the cuts in the shallow parts of the lake will be from 500 to 1,000 feet wide. The minimum depth of the canal will be 41 feet.

The total estimated excavations required by the present plans for the lock canal are in round numbers 175,000,000 cubic yards, of which up to March 1, 1909, has been excavated 66,000,000, with an amount yet to be excavated 115,000,000, so that considerably over one-third of the excavation work has been done. It is therefore estimated that, taking into consideration the work on the dam and the concrete in the locks, the canal will be open for traffic by the first of January, 1915.

STEAM-SHOVEL EQUIPMENT.

The excavating is done by means of steam shovels in the dry portions and by dredges in places covered by water. Mules and scrapers are used for stripping in some places. There are

now in use on the Isthmus 101 steam shovels—48 ninety-five-ton, 42 seventy-ton, 10 forty-five-ton, and 1 thirty-eight-ton. The ninety-five-ton shovel holds 5 cubic yards and dumps into flat cars, each car holds 7 shovels, or 35 cubic yards. There are 17 cars in each train. As each car is loaded the train moves slowly on until all the cars are full, and is then hauled to the dump, and unloaded by the Lidgerwood unloader as follows: The flat cars have side boards on one side only and no end boards, and the spaces between the cars are covered with steel plates. The unloader, which is a plow-shaped affair, is drawn from the rear end of the train to the front by means of a steel cable attached to a steam winch on a special car next to the engine. When the plow gets to the flat car next to the winch it is stopped and the car with plow is detached.

To repeat the operation, the train is made up with the car containing the plow attached to the rear end; it is backed up until the winch is under a gallows frame arrangement set over and across the track. The cable is then hooked on to the frame and the train is run forward until the plow is under the frame, the cable taken from the frame and attached to the plow and the train is ready to be unloaded at any convenient place. It is very interesting to watch a train unloading by this method, the plow slowly advancing and pushing earth and rock, in many cases huge boulders, from the car to the dump.

In excavating by steam shovels, the ground is first loosened, and rocks shattered by means of dynamite.

Besides the cars used in connection with the Lidgerwood unloader there are in use steel dumping cars holding about 30 cubic yards which are unloaded by air pressure from the engine. A whole train may be dumped at one time. The steam shovels work very rapidly. The average time of several cars in the Culebra cut was about one minute and a half. Of course, this does not represent the actual work done in a day of eight hours. There is a good deal of time consumed in moving the shovels, shifting trains, etc. The highest daily record for a single shovel is something over 1,600 cubic yards per day of eight hours.

EMPLOYEES.

In the month of February, 1909, there were on the Isthmus about 41,000 employees on the roll of the Commission and the Panama Railroad Company, of which 5,000 were Americans.

There were actually at work on February 3, 31,071 men; 24,911 for the Commission and 6,160 for the Panama Railroad Company. Of the 24,911 men working for the Commission 4,278 were on the "gold roll," so called, who were paid in United States currency, and 20,633 on the "silver roll" who were paid on the basis of the Panama currency or its equivalent. Those on the gold roll include skilled mechanics, locomotive engineers, machine-drill men, etc., clerks and higher officials. They are for the most part Americans. The silver roll includes the common laborers, who are practically foreigners.

The working day is eight hours. The men begin at 7 A.M.; work until 11 A.M.; take the midday meal, rest until 1 P.M., and work until 5 P.M. They are carried to and from their work by train. The Negro laborers use open cars or the roofs of cars, where they bask in the sun; white men prefer closed cars.

The majority of the laborers employed on the canal are drawn from the West Indies. When we were on the Isthmus there were 52 different nationalities on the pay roll according to the languages spoken by the employees. There were from 5,000 to 6,000 Europeans—mostly Spaniards from the north of Spain—and some Italians; the former constitute by far the best class of laborers on the Isthmus. The Italians are good workmen but rather hard to manage. The Negroes are, like all that class of laborers, poor. We had an illustration of this at the Tivoli Hotel in Panama. A negro was set to work cutting the grass on a plot, an oval, about 175 feet long by 50 feet wide, say 300 square yards. He was supplied with a lawn mower, a scythe, and a rake. He started to work the day we arrived and it took him just a week to complete it. It is true that the grass was thick and heavy, and he spent a good deal of time in meditation and smoking cigarettes.

GATUN DAM.

The most striking features of the canal are the Gatun dam and locks, about which so much has been written in the newspapers, and the Culebra cut.

The Gatun dam will impound the waters of the Chagres and the rivers emptying into it between Gatun and Pedro Miguel, forming the Gatun Lake with a surface area of some 165 square miles. The dam is about 8,000 feet long, across the valley of the Chagres. It will be 2,000 feet wide at the base, and 115 feet

high. The crest of the dam is 100 feet wide and 30 feet above the mean water level of the lake. It is an earth dam with a core of puddled clay impervious to water, 700 feet wide at the base and rising to 90 feet. This will be made by hydraulic fill.

About the centre of the valley is a hill rising some 110 feet above sea level. It is here that the spillway of the dam is located. It is of concrete and fitted with sluice gates, so that any amount of surplus water may be allowed to waste. In view



Reproduced from *Engineering News*.

Cross-section of Gatun Dam.

of the vast surface area of the lake, however, it is doubtful if any amount of water will necessarily be wasted.

FOUNDATIONS OF THE DAM.

There has been a great deal said about the foundations of the dam—that it is soft mud, that it is fissured rock and that it is permeable by water, that it has underground water courses,—indeed, were we to listen to the hostile critics it would seem ridiculous to attempt to build any dam whatever at that spot.

In a most admirable report on the Gatun dam investigation, page 127, Report of the Isthmian Canal Commission for 1908, Mr. C. M. Saville, Asst. Engineer, gives the result of exhaustive investigations of the foundation of the dam by test pits and bore holes. The report shows conclusively that the foundation is safe and that a dam can be built which will fulfill all the requirements of the case. It is true that water was found in some of the holes, it is also true that fissured rock was found and that water did appear through some of the cleavage planes. But Mr. Saville's conclusions are in favor of building the dam at that place. He finds:

"First. That suitable material is available and near at hand for the construction of the Gatun dam by hydraulic process.

"Second. That the foundations are suitable for such a structure as the proposed Gatun dam if they are properly treated.

"Third. That it is practically possible to construct a stable and water-tight earth dam at Gatun of the material available."

"Fourth. That the hydraulic method of construction as proposed for this work is feasible if proper conditions are observed."

And that is just what they are going to do.

To quote, in this connection, from a paper entitled "The Isthmian Canal," by Lt. Col. George W. Goethals, U. S. A., Chairman and Chief Engineer Isthmian Canal Commission, Washington, March 16, 1909: "I venture the statement without fear of contradiction, that the site of no public or private work of any kind has received such a thorough and exhaustive examination and investigation as the foundations of the dam and locks at Gatun. There is no longer a doubt concerning the underlying strata; neither the impermeability nor the ability of the foundations to bear the loads that will be brought upon them can be questioned if the data be carefully and impartially examined."

Here we have the word of an eminent engineer who is responsible for the success of the work, whose reputation would be affected by the failure of the dam. By referring to the plan of the dam, you will see the numerous borings made in the foundations which supply the basis for Lt. Col. Goethals' views. Besides this, five test pits were sunk, into one of which Mr. Taft descended when he was last on the Isthmus.

THE LOCKS.

The locks will be built double, of concrete, three in flight; each lock will be 1,000 feet long and 110 feet wide. They will be fitted with double gates. The lift of each lock will be 28 feet 4 inches, making the total for the three 85 feet. The pier dividing the locks is 50 feet wide and will extend 1,000 feet beyond the ends of the locks. Vessels coming into the locks will make fast to this pier and will be put through the locks by electrical machinery. They will not pass the locks under their own steam, so that there will be no danger of their rushing in under full headway and carrying away the gates. There will be an emergency dam which can be used at the upper end of the locks to shut the water off in case of accident.

Leaving the Gatun Dam vessels will steam up the Gatun Lake, 85 feet above the sea level, to the Culebra cut. The Gatun Lake is a very important feature of the canal. On account of the surface area there will be no speed limit for vessels passing

through, and the lake disposes once and forever of the danger of floods in the valley of the Chagres. It will be an agreeable diversion from the monotony of a sea voyage to sail through this inland sea surrounded by mountains clothed with tropical vegetation.

The Culebra cut crosses the Cordillera at a point where the highest elevation is 330 feet above sea level. As the bottom of the cut will be 40 feet above sea level it would make a vertical cut 290 feet at the deepest part. The bottom of the cut is now about 85 feet above the final level.

At Pedro Miguel, pronounced by the Americans Peter Magill, there is one lock with 30 feet lift, thence to Miraflores, about one mile and a half, where there are two locks in flight with a total lift of 55 feet. All of these locks are double. At Miraflores there is a lake of about 2 square miles surface area formed by the locks and a small dam. From here there is a tide-level canal to the Pacific Ocean.

HOUSING AND FEEDING THE EMPLOYEES.

Housing and feeding the large number of employees was a very important question which has been most successfully met. In addition to the old French houses which have been reconstructed, the Commission built over 5,000 houses. They are enclosed in brass wire netting for protection against mosquitoes. There are married and single quarters for whites.

Subsistence is supplied by hotels, European laborers' messes, and the common laborers' kitchens. Commissaries are established at the various towns along the line of the Panama Railroad. They supply the needs of the people at prices about equal to what is charged in the United States. I can personally bear witness to the excellent quality of the food which I got from these hotels.

SANITATION ON THE ISTHMUS.

But the most noteworthy department is that of Sanitation. When the Canal Commission took charge there was a total lack of sanitation on the Isthmus and yellow fever and malaria were very prevalent. In 1905 there was an epidemic of yellow fever and almost a panic among the white employees of the Isthmian Canal Commission. Col. W. C. Gorgas, U. S. A., who has been so successful in fighting yellow fever in Cuba, took charge of

the work and has succeeded in making the Isthmus as healthy as any place in the tropics. It must be remembered that the streets of Colon and Panama were not paved, and there was no water supply and no sewage system in either city. Col. Gorgas took charge and there is now a good water supply available in Colon and Panama and the points along the canal; the streets are paved and a sewage system installed. There has not been an original case of yellow fever on the Isthmus in the last two years and malarial fever is steadily decreasing. There are practically no mosquitoes in the towns in the zone. This result has been obtained by the persistent use of oil where the insects breed, and by keeping the grass and brush-wood cut close in the neighborhood of habitation and along the line of the Panama Railroad.

The work done in the sanitation of the Isthmus has been stupendous and too much credit cannot be awarded to Col. Gorgas and his assistants.

The principal hospitals are situated at Colon and Ancon in Panama and there are sick camps and dispensaries at convenient stations along the line. There is also a sanatorium for convalescents on Taboga Island at Panama.

The death rate in 1908 among the white employees was 15.34 per thousand. About one-third of this death rate was due to accidents and violence. The death rate among the blacks was 19.48 per thousand. The reason for the excess among the blacks was the lack of sanitary precaution among them.

SOCIAL LIFE.

The material wants of the employees being thus provided for, attention is also given to the social side of life on the Isthmus. On the principle that the happier and more contented a man is the better service will he render, amusements are encouraged and athletic sports are fostered. There is a band composed of employees, maintained by the Government, and concerts and dances are given every week alternately at the various stations along the line. Almost every town has its base ball team and they have what one may call inter-city games.

At Ancon there are tennis courts laid out by the Government which are extensively patronized. A feature of life on the Isthmus is the work of the Young Men's Christian Association.

Club houses have been opened at various points where the number of employees is sufficient to warrant their opening. These club houses have libraries, gymnasiums, entertainment halls, etc., and there are frequent open-house receptions and public entertainments. We visited the club house at Culebra and were much pleased with everything we saw. Besides these there are bowling clubs, musical and social clubs along the line and last but not least many women's clubs whose members doubtless discuss everything under the sun from the rearing and management of infants to the election of the President of the United States.

Medals are awarded for two years continuous service on the Isthmus subsequent to 1904, and for each two years additional service a bar will be awarded to be attached to the medal. Only American (or naturalized), citizens are eligible for medals.

The children have not been neglected. In 1908 there were eleven schools for white children and fifteen for black children at places along the line.

The Canal Record, published weekly under the supervision of the Commission, gives a report of progress for each week with details of work accomplished at various points. Also a portion of its space is devoted to social matters and discussions upon various subjects. Thus when we were there a lively controversy was going on as to who was worth more to the community—a married man or a bachelor. The papers and arguments were very creditable and some of the views quite novel.

Under all these conditions we can readily see that a certain amount of enthusiasm and *esprit de corps* have resulted which make this an ideal force, and one has only to observe the bright and earnest faces of the men who are doing the work to feel assured that they are doing their utmost not for pay alone, but that they are the people who are doing the most wonderful engineering work in the history of civilization.

CITY OF PANAMA.

Just a few words on the city of Panama. The city of Panama, the capital of the Republic, was founded in 1672, about a year after the destruction of old Panama by Morgan and his buccaneers. It is to-day a town of some 35,000 inhabitants and in nowise differs from the ordinary Spanish-American town one

finds throughout the West Indies, except that the streets are well paved and that it has an ample supply of good water and an excellent sewage system, which it owes to the American occupation. The streets are clean and well policed. There is a very fine Opera House built, by the way, with part of the money paid by the United States for the concession of the canal zone. The public buildings are creditable. The sea wall on the bay side is fine and forms a promenade for the citizens. There are a few ancient cannon mounted on the sea wall, the carriages being mostly decayed. We could not decipher the inscriptions as the metal was much corroded, but they are doubtless very old.

The most notable object, however, is the ruin of the old Jesuit church of San Domingo, in which is the celebrated flat arch. The span of this arch is 36 feet. There is no burden on the arch, it stands there as it was built. The story goes that the architect failed twice. The third time he uttered a prayer—some say to San Domingo, some say to the Devil,—but in any event he stood under the arch when the supports were taken away for the third time and the arch stood. The church is about 200 years old and the existence of the walls and the arch is a refutation of the reports of frequent earthquakes about which we hear so much. Indeed people, whom we met in Panama, who had been on the Isthmus since 1904 were unable to give us any information about earthquakes in that region. Panama has the distinction of being the first diocese established on the American continent.

Panama has no army and no national debt. As the United States guaranteed the independence of the republic, there is no need for an army and, as they are a slow-going and conservative people, they are unable to see the necessity for a national debt.

LOCK-TYPE CANAL.

There has been a campaign, conducted with much sound and fury, against the lock type of canal and in favor of the sea level type. There has been so much said by the advocates of the sea level system and so much ignorance of existing conditions displayed, and misrepresentation made, that a few words on the subject may not be amiss. It is only fair to say, that before visiting Panama, I shared the prejudice in favor of the sea level type. The advocates of the sea level canal may be divided into

two classes—those who are in favor of a canal without dams and locks, with no provision made for the control of the Chagres and other rivers, trusting to the canal itself to carry away the surplus water when these streams are in flood, and those who would control the Chagres, etc., by means of dams and diversion canals, upon a somewhat similar plan to that originally contemplated by de Lesseps.

The first plan is not worthy of serious consideration. The second plan contemplates a masonry dam at Gamboa 4,500 feet long, 750 feet of which would have to bear a pressure of 170 feet of water during the flood stages of the river. Sluice gates would be arranged to discharge the river into the canal, but there would probably have to be a diversion canal to carry off the surplus water. They make, in their plans, no provision for taking care of the other rivers which would flow into the canal, but there would be at least three or four other dams and a diversion canal on the west side of the sea level canal, as de Lesseps started to build it. Moreover the canal would only have a bottom width of 150 feet, except in the Culebra cut where it was proposed to make it 200 feet.

This type of canal would be open to all the objections brought against the lock type, and it would not be one half so efficient. The dam, with the Gatun Lake, controls the Chagres and makes it an efficient servant instead of a dangerous enemy. Instead of a narrow, crooked ditch with currents and counter-currents to make it dangerous to navigation, we have a broad and safe lake with no current at all. Instead of a carefully thought out and well matured plan, we would have only an idea even the authors of which are not in accord as to the means of carrying out.

There is only one thing to be feared in the lock plan, viz., earthquakes—and that danger is very remote, and if a bad one occurred it would be equally disastrous to the Gamboa and other dams, as to the dam at Gatun. One of the reasons urged in favor of the Panama route was the freedom from earthquakes in that region. But the advocates of the sea level, or rather the opponents of the lock canal, pay heed to none of these considerations. They fill the air with denunciations of the dam and locks, and clamor for a sea level canal, whatever it may be—only a sea level canal!

I wish to acknowledge my indebtedness to Senator Thomas C. Carter, to Capt. F. C. Boggs of the Isthmian Canal Commission in Washington, to Governor J. C. S. Blackburn of the Commission in Panama, to Lt. Col. Hodges, to Major W. L. Sibert and Major I. P. Jervey and Col. Gorgas. I wish to thank these gentlemen for their kindness and unfailing courtesy and readiness to give any information in their power. In fact, we found all, officers or employees, high or low, most ready to give us any facts or figures which we might ask for. I shall look back with pleasure to the time I spent on the Isthmus viewing the grandest engineering work of civilization.

I have tried to set before you the condition of affairs on the Isthmus and show the advantages of the adopted plan. I have done this, I know, very imperfectly, but it does seem to me that the testimony of the gentlemen engaged in this work, in view of what they have already accomplished, of their high professional standing and of the careful and painstaking investigations they have made, that their testimony and opinion should outweigh the opinions of those who, in criticizing, have no definite idea of what should be offered in exchange.

PEAT AS FUEL.

ORIGIN AND CHARACTER.

Peat is partly decomposed vegetable matter that has formed either where the ground is saturated with water most of the time or where it is permanently covered with water. It is the dark-colored or nearly black soil found in bogs and swamps, commonly known as muck, although technically a distinction is made between peat and muck, the latter name being restricted to those forms of swamp deposits that contain too much mineral matter to burn freely. Dry peat may be very fibrous and light colored, or compact and structureless and dark brown or black. It is usually somewhat lighter in color when dry than when freshly dug. When wet it contains as a rule from 80 to 90 per cent. or more of water; that is, a short ton of wet peat rarely contains more than 300 pounds of dry peat and may yield as little as 100 pounds. In the wet condition it is entirely non-combustible, and the various processes by which it is prepared for use or market consist principally of methods for ridding it of water quickly and cheaply and for increasing its fuel efficiency and transportability.

A VALUABLE RESOURCE.

The great peat deposits that are widely scattered in the northern part of the United States have at various times aroused strong public interest. In the winter of 1902-3, for instance, when the strike of the coal miners in the anthracite region of Pennsylvania brought the country to realize that it was to a large extent dependent on these miners and their employers for an important part of its fuel supply, a number of writers familiar with the conditions in the countries of northern Europe called attention to the fact that those countries, possessing a climate much more severe than ours, were using