Workings of the Great Locks of Panama Canal

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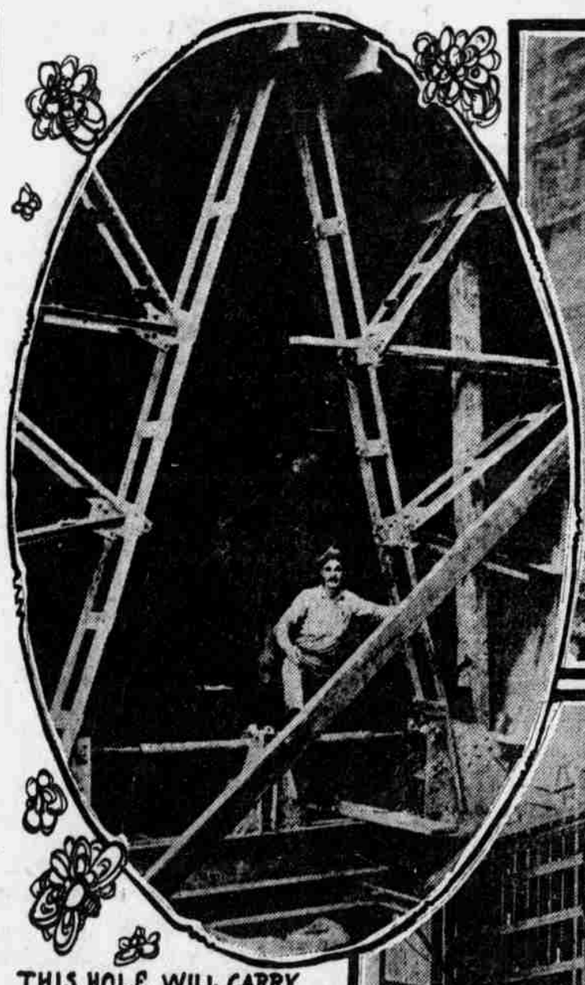
MIRAFLORES, Canal Zone, Panama.—I am writing these notes this bright Sunday morning in the great locks at Miraflores. I am within eight miles of deep water in the Pacific ocean and at the two first great steps up which the steamers will climb on their way across the the Atlantic. Beyond this is Miraflores lake and at its end the lock of Pedro Miguel, which, with its boost of thirty feet, shoves the vessels to the level of the Culebra cut, where the canal will be eighty-five feet above the surface of the sea below.

It is quiet here today, for Uncle Sam keeps the Sabbath. The men have stopped work, the mighty cranes loaded with spoil stand on the tracks. That steam shovel down there to the right is black and dirty and it gives no indication of the work it has done the last week.

How hot the sun is and how dazzling! The concrete which walls the lock is made of white sand and where it catches the rays it is blinding. How high the walls are! I am in a mighty chamber in which you could drop two city blocks of six-story houses and there would be still room to spare.

I walk over to one side and look up with my chin touching the concrete wall. The whole earth is shut off and the wall reaches the sky. It looks like a smooth white sandstone put together in blocks bigger than those of the pyramids, but far smoother and more closely laid. It is a solid wall and was molded as such, the appearance of blocks coming from the joints in the molds. Midway in the wall is an iron ladder about two feet in width. I laboriously climb to the top and it seems as though the ladder would never end.



THIS HOLE WILL CARRY THE FLOOD INTO THE LOCKS AT GATUN

CONCRETE BUCKETS IN LOCKS AT MIRAFLORES.

ERECTING THE MIGHTY GATES AT GATUN

The Locks of the Canal.

These locks are about the most interesting features of Uncle Sam's mighty Panama works. The ditch itself is wonderful, but its construction has been merely a matter of blasting out earth and rock and carrying them into the hollows or down to the sea. The locks are remarkable creations in that here man tries to imitate nature and he has built these gigantic rock masses, molding sand, cement and rock into stone.

There are six great locks on the canal. It does not sound big as I write it, but these locks contain cement by the millions of barrels. They have shiploads of sand which has been brought from the Atlantic and Pacific, and mountains of rock have been blasted out and crushed to form their concrete. The materials are now so united that they are one solid stone. Let me give you some idea of the extent of the concrete alone. They contain over 4,000,000 cubic yards, or enough of this artificial rock to make a solid wall fifty feet high, ten feet thick and over fifty miles long. Such a wall would reach from Washington to Baltimore and have ten miles to spare.

Each of these locks has a twin. The whole consists of two mighty chambers, the side walls of which are about fifty feet wide at the bottom and grow narrower and narrower as they come to the top, where the width is eight feet. They are about eighty feet high. There is another wall in the middle which is sixty feet wide, and within these walls are the two mighty chambers which are closed at each end by the gates.

No Salt Water in the Canal.

So much for the outlines of the structure. The foundations of the locks are as complicated as a catacomb. They have tunnels and galleries running this way and that, and in their floors are many great holes as big as a flour barrel where the water comes into the chamber so fast that they can be filled or emptied in the space of eight minutes. The water is admitted by mighty culverts or conduits which run along the side. These are tunnels through the concrete construction and they will carry rivers from Lake Gatun to lift and lower the vessels.

You often hear it said that we are bringing the waters of the Atlantic and the Pacific together. This is so only figuratively speaking. There will be no salt water in the canal except at the ends. The locks will be filled with fresh water from Lake Gatun and it will be the Chagres which we shall harness and make pull up and let down the steamers from ocean to ocean.

But let me tell you more about these big tunnels, into which the water first flows. They are so huge that you could drive a caravan of elephants and giraffes through them, and the elephants might walk four abreast and not touch the sides, while a monkey seated on the head of one of the giraffes would not reach the ceiling. They would easily hold a Pullman train, and a brakeman might stand on top and not ruffle his hair.

These great tunnels or culverts are connected by pipes which run down to the bed or floor of the lock chamber, and which are so arranged that when the water is let in it rushes up through the openings and fills the chamber, the water being held in by the gates.

There are only two locks here at Miraflores. The steamer comes straight in from the Pacific when the water in the lock is at sea level. This water is salt. Then the gate at the Pacific end is closed, and in from the tunnel comes the water from the Gatun lake, having passed through the Culebra cut and Miraflores lake. It fills the lock, raising as it does so the ship to the level of the water in the lock above.

The vessel then passes into that lock, through the gate facing the Pacific, and it is raised to the level of the Miraflores lake and steams through it until it reaches the lock of Pedro Miguel. Here in the same way it is boosted thirty feet higher to the eighty-five-foot level of the Culebra cut. The ship now has a clean, clear steaming way of thirty-one miles, including the cut and the Gatun lake, before it comes to the Gatun dam and to the three series of locks which drop it down to the level of the Atlantic.

The matter is simple enough. It is merely like putting a block of wood in a tub and pouring in water to make it rise to the top, or like opening a spigot in the bottom and letting it drop as the water runs out. The only difference is that the block is small and it weighs but a few pounds, while the ship which will go through these gigantic lock tubs may be as long as was the Titanic or longer and it may weigh tens of thousands of tons. The Olympic, for instance, has a gross tonnage of 60,000, and, I am told, it could easily pass through. The actual dimensions of each of the chambers are 1,000 feet long, 110 feet wide and more than eighty feet high.

Gates Which Cost Five Million.

The gates to these chambers are even more wonderful than the chambers themselves. The chambers are of concrete. The gates are of steel, and that in thousands, yes, millions of pieces, put together so tightly that they will hold these huge vats of water and raise and lower within them vessels worth millions of dollars.

But first as to the cost. I have said $5,000,000. The actual sum is more than that. The contract for making them was let by competitive bids in which the United States Steel trust and four others of the chief steel manufacturing companies of the United States submitted offers. Each had to put up checks for several hundred thousand dollars as a guarantee that it would carry out its bids, but these sums were returned to those who failed. The lowest bidder was the McClintic-Marshall Construction company of Pittsburgh and its offer was $5,375,000. This was for the making of forty-six gates, being on an average almost of $117,000 apiece.

The sum seems great until one realizes just what it covers. It includes altogether something like 58,000 tons of steel made up of tens of thousands of pieces, some so big that it takes a mighty steam crane to handle them and others as small as a pin or a needle. For instance, there are more than 400,000 pounds of steel bolts and pins and 500,000 pounds of nickel steel pins. There are millions of pounds of riveted structural steel, over 3,000,000 pounds of carbon steel castings and hundreds of thousands of pounds of Vanadium steel, made up in an infinite variety of parts.

Some Interesting Items.

I have before me the items which formed a part of the bid. They include twenty gates for the Gatun locks, twelve for the locks at Pedro Miguel, and fourteen for those here at Miraflores. Some of the gates are seventy-seven feet high and some as low as forty-seven feet four inches. Each is made in two leaves or doors which swing back and forth. Think of a door as tall as an eight-story house. Make it about fifty-five feet in width and you may get some idea of these mighty doors, each containing its myriad parts of steel, put together like a watch, which have been made at Pittsburgh and shipped in pieces down to the canal. The weight of the biggest leaves is something like 600 tons, or enough to form a good load for a dozen freight cars.

Think of hanging gates of that kind in such a way that they can swing back and forth at a speed that will not affect the waters which flow in and out, and at the same time quickly enough to allow ships to go through these locks within eight or ten minutes, and you have some idea of the difficulties of their construction.

The Locks in Miniature.

The government has made a working model of these gates in the shops at Gorgona, and it will be on exhibition at the great fair at San Francisco. It is made on a scale of a half inch to a foot, and it shows not only the construction of the lock chambers, but the method of operating the gates and other machinery. This model is only six feet, four inches long and eight and one-half feet in width. It looks exactly like a lock in miniature with the gates at the end. The gates are perfect imitations, having pins for every rivet and in all about 110,000 pins on the sheet copper which covers them. They are operated by a one-fifteenth horsepower motor and are equipped with such devices that the operation is automatically controlled just as it will be in the great locks here at Miraflores and elsewhere.

How the Ships Go Through.

The vessels are not allowed to move from one lock to another by steam. They are towed by electric locomotives, and there are a number of protective devices to see that they do not injure the locks or themselves on their way through.

There are four towing locomotives, which run upon tracks on each side of the lock. Two of them are fastened to the front of a vessel, moving it onward, and the other two are on the tracks at the rear holding it back so that it can go only so fast. The rate fixed is to be two miles an hour and the locomotives will prevent it being more or less than this.

These locomotives will run on a level excepting where they pass from one lock to another, where they will climb up or down heavy grades. Between the lower and intermediate locks at Gatun, for example, the difference in elevation is over twenty-nine feet.

There are to be two systems of tracks, one for towing and the other for the return of the locomotives when not towing. The towing tracks will have a center rack and the locomotives will always operate on this rack. On the return track there will be also a rack on the incline between the locks, but elsewhere the cars will run by friction.

The motive power for running these locomotives will be electricity, generated by the spillway of the Gatun dam. This, it is believed, will furnish enough electricity not only for all the machinery of the canal, but possibly enough to run the trains of the Panama railroad.

Chains to Hold the Ships Back.

In addition to the locomotives, the locks have other means of keeping the steamers from striking the gates or going too fast. Among these are chains which run across the lock chambers from one side to the other.

These chains are so powerful that they could stop a 10,000-ton vessel going at a rate of four miles an hour within a distance of sixty feet without injuring either the ship or the chain. The chains run across from lock wall to lock wall and from the approaches passing down into holes in the walls in such a way that they play out gradually when struck by the vessels, retarding them and bringing them to a stop. The chains are also so arranged that they can be lowered and dropped down into a groove in the bottom of the lock floor so that the vessel steams out over their tops.

These chains are enormous. Each link will be oval in shape. Its longest diameter will be as big as the largest dinner plate, and the steel of the link will be about as thick as your wrist. In addition the gates will be double, the upper gate acting as a protection to the lower, so that both would have to break before any damage could come to the lock.

In addition to all these there are to be emergency dams at the upper end of each set of locks which will work something like a drawbridge and thus protect the locks.

The Water for the Canal.

One of the live questions in connection with the locks is whether the Chagres river can furnish enough water to keep them full and still accommodate all the traffic that will pass through the canal. The engineers say that it can. The Gatun lake is now filling and when the canal is completed we will have 164 square miles of water held back by the dam, and this in addition to the regular flow of the Chagres. We shall also have something like two square miles of water in the Miraflores lake.

Engineer Rousseau says that the water supply will amount to more than 80,000,000 tons per annum, and Colonel Goethals says that there will be plenty to accommodate fifty-eight vessels a day, going through the canal, and that this would be more than could pass through in the space of twenty-four hours. It is doubtful whether such a traffic will ever arise. Even forty vessels a day on the average for 360 days of the year would mean 12,000 vessels, and this is about three times the number which is now going through the Suez canal. The number there amounts to something like 4,000 and the tonnage is in the neighborhood of 20,000,000 per annum, which is just about half the gross tonnage passing through our canal at Sault Ste. Marie.

Uncle Sam's New Lake.

And just here I would like to say something about Uncle Sam's new lake which is now rising out of the jungle. The Gatun dam will soon be finished and it will hold back the Chagres, forming one of the most beautiful sheets of water on earth. The steamers will enter it from the verdure-clad mountains at Culebra cut, or from the massive locks at Gatun and will move for twenty odd miles through scenery as beautiful as that of the inland sea of Japan, or of the Thousand Islands of the St. Lawrence. The canal channel runs in and out among islands covered with tropical plants and trees which will then be the home of monkeys, birds, deer and other wild game, for the idea is to drive man from the canal zone and make it one great game preserve. These islands are well fitted for that as far as aquatic creatures are concerned. Wild ducks are already beginning to come, and we shall have parrots and paroquets and possibly the gorgeously plumed macaw of the Amazon.

The Gatun lake will drain a basin bigger than Rhode Island. It will have an area equal to 500 quarter-section farms, and over this the water is fast rising. Much of the bed is still covered with vegetation and with forests half sunken in the waters.

Uncle Sam Playing Noah.

One of the interesting features of making this lake is Uncle Sam's attempt to play Noah. He has warned the inhabitants of the basin to come out, and has asked them to get on his ark, by which he means the highlands outside. The natives, however, refuse to believe in the deluge. They say that the French threatened them with the same fate, and that nothing came. Some of them have stayed in their homes until the steam shovels have lifted their front door steps, and others until the water has covered their floors. Now they all have boats tied to their houses and there will be no loss of life as the flood comes.

The government has already torn down and carried away all the heavy canal structures out of the lake bed. A number of the towns have disappeared, and masses of ruins lie along what was once the main railroad track. Old Bohio has been swallowed, and the same is true of other towns. In tearing down the houses one was found which was built of solid mahogany. The lumber of this has been saved and remade into furniture.

FRANK G. CARPENTER.

An Apprehension.

"What will be the result of woman's suffrage?"

"It will make a political career more difficult for some of the married men," replied Senator Sorghum. "A candidate is liable to be kept busy keeping the family vote from going against him because of temporary misunderstanding. He won't have time to give proper attention to the masses."—Washington Star.