

DIGGING THE PANAMA CANAL

The Canal Today

The Isthmus of Panama lies in an east-west direction, its northern side on the Caribbean and its southern side on the Pacific Ocean. Seen on a map, the canal runs north-south, extending 51 miles from Colón on the Caribbean to Panama City on the Pacific. A trip along the canal from its Atlantic entrance would take you first through a 7 mile dredged channel in Limón Bay. You then proceed for 11.5 miles to Gatún where a series of three locks raises ships 83 feet to Gatún Lake, which was created by building a dam to contain the Chagres River. Our journey continues south for 32 miles across Gatún Lake to Gamboa and the Culebra Cut. This channel cut, which is 8 miles long and 493 feet wide, crosses the continental divide and ends at the Pedro Miguel locks, which lower ships 31 feet to another lake and finally to the Miraflores Locks. There, ships are lowered a further 52 feet to sea level at the canal's Pacific terminus in the bay of Panama.

Early history

In the early sixteenth century the Conquistadores first recognized the desirability of a canal through Central America. After plundering South America, chiefly Peru and Ecuador, they faced a two-month voyage home of more than 15,000 miles, including the perilous trip around Cape Horn. In 1513, one of these voyagers, Vasco Núñez de Balboa, marched across the jungle of the Central American isthmus in only four days. Balboa named the large sea he discovered the *South Sea* and claimed it for the Spain's King, Charles V; Magellan later renamed it the *Pacific*. Explorers, among them Columbus, Magellan and Cortez, probed the Caribbean and Pacific coasts of Central America seeking a waterway that would spare them the long, treacherous trip around South America. Charles claimed a large piece of Central America as the possible site of a future canal. In the sixteenth century, this was only a pipe dream.

Nineteenth Century

Surveys made between 1850 and 1875 identified two practical canal routes across the isthmus, one across Panama, the other through Nicaragua. Today's Panama was then a province of the nation of New Granada (roughly present day Colombia, Venezuela, Panama and Ecuador). In 1855, the French had built a railroad across Panama, allowing goods and passengers from the U.S. East Coast or Europe to travel by ship to Colón. From there they would travel by rail to Panama City on the Pacific, then board another ship for San Francisco. This route carried very heavy traffic in the latter days of the California gold rush. In 1876, Ferdinand Marie de Lesseps, a Frenchman, proposed constructing a sea level canal through Panama. De Lesseps, who was famous for his successful construction of the Suez Canal just ten years earlier, was supremely confident that he could achieve similar success in Panama.

Meanwhile, Cornelius Vanderbilt was pushing for a canal in Nicaragua, where he had major business interests. Vanderbilt's engineer, Orville Childs, surveyed the land between Lake Nicaragua and the Pacific and discovered a pass that was only 155 feet above sea level, a full 121 feet lower than the summit of the Panama Railroad. According to this survey, a Nicaraguan canal would be two to three times longer than a Panama route, although it might be easier to build because it would incorporate Lake Nicaragua, a very large, navigable body of water in the

west. The route would thus require less digging and present fewer engineering problems. And Nicaragua was not the disease-ridden death trap that Panama was.

In May, 1879, an international congress chaired by de Lesseps drew 136 delegates representing 22 countries to Paris, to study the feasibility of an inter-oceanic canal and discuss the competing routes. More than half the delegates were French, but most were not engineers. Despite profound disagreements, it was clear that the Nicaragua plan, complete with locks, as presented by the American delegate Anceto Menocal, had the most substance. Menocal's plan essentially followed and fleshed out the Childs survey. But de Lesseps would have none of it. In a long, persuasive speech favoring a sea level canal in Panama, he dismissed all other plans as too costly or otherwise impractical. Unfortunately he ignored the geographical differences between Suez and Panama, one a desert, the other a jungle with mountains. Nevertheless, his passionate oration enthralled the audience and produced a majority vote favoring his proposal. To top it off, the vigorous 74-year old proclaimed that he himself would take over as president of the French Canal Commission.

Celebrated as an authentic hero for his Suez triumph, de Lesseps was lavishly feted wherever he traveled. On one occasion, more than thirty thousand jubilant people filled London's Crystal Palace to honor the builder of the 105 mile desert passage that brought Europe 5,800 miles closer to India. Denunciations of that project by men reputedly far wiser than he, made de Lesseps' triumph all the more satisfying. De Lesseps had great faith in the advanced French engineering expertise and imagination which were responsible for other grand projects in the latter half of the nineteenth century, including the Eiffel Tower and the Statue of Liberty.

Initial funding for the project came through the private sale of stock to a few wealthy friends of de Lesseps. Later, shares were made widely available. De Lesseps' prestige alone was thought to guarantee an excellent return, tempting the thrifty French populace to pour their savings into his company; they kept on pouring until the bubble burst, bringing ruin to thousands and driving scores to suicide.

The French canal company began to dig in Panama on Jan. 20, 1882, and was beset almost immediately by monumental problems. The digging equipment, although state of the art for the time, was not up to handling some of the large boulders it encountered. In addition, the contractors who purchased equipment and supplies were poorly coordinated. A glaring example was the purchase of railroad wagons whose gauge did not fit the rails of the trans-isthmus railroad. Even more of a concern was the high incidence of tropical diseases among the laborers imported from the Caribbean, China, North America and Europe.

In fact, the French company, recognizing the necessity of disease control, had built a large hospital near Panama City, and a smaller facility near Colón. By the time the U.S. took control of the project in May, 1904 it was estimated that about 12,000 men had died during the construction of the Panama Railway and 22,000 during the French effort to build the canal. We cannot verify the accuracy of these numbers because so many of the foreign laborers lacked official documents. Large numbers were buried in unmarked, makeshift graves.

To lure workers to Panama, some truths about the isthmus were concealed. Nobody mentioned the diseases – malaria, smallpox, Chagres fever, pneumonia and yellow fever – that fed bodies to

the "death train," on its many daily trips from Colón to the cemetery about halfway between Colón and Panama City. Hundreds of great black vultures hovered constantly over the city.

Despite the wretched conditions imposed on West Indian laborers – they were treated as expendable by both the French and the Americans - some of their personal accounts were full of pride in knowing they were part of a great, heroic achievement. One laborer commented, “We worked in rain, sun, fire, gunpowder explosions from dynamite, but our interest was to see the Canal finished because we came here to build it.”

There was also friction among the groups of laborers. In the worst incident, native Colombians used machetes and guns to massacre dozens of Jamaicans at Culebra. The massacre was symptomatic of a wide disregard for the rights of the imported workers, coupled with a strong prejudice against non-Spanish speakers.

In early 1885, a major fire destroyed most of Colón, creating a bottleneck for the import of machinery and supplies; the Culebra massacre had brought labor shortages all along the line. April saw exceptionally heavy rains which stalled the work and triggered more landslides. The New York Tribune said “...the Panama canal is in such a (disorganized) state that its ultimate completion is beyond question, but it appears equally certain that the present company can never complete it...”

Faced with dwindling finances, de Lesseps asked the French government to issue bonds to fund the Canal effort. The government refused. Finally, in December, 1888, work stopped and the French company declared bankruptcy. To their credit, the French had excavated almost eighty million cubic yards, including more than 18 million from the Culebra Cut, the lowest point of the continental divide, lowering the peak by 335 feet. They left behind large quantities of machinery, housing, a hospital and an impressive engineering accomplishment achieved despite crucial administrative failures.

In 1892 it was revealed that 150 French diplomats had accepted bribes for supporting financial aid to the Panama Canal Company. By the next year, de Lesseps, his son Charles and several others were found guilty. De Lesseps was fined and sentenced to prison but this was overturned.

Mosquitoes

Although some had suspected an insect vector, few physicians in the late nineteenth century believed that mosquitoes helped transmit malaria and yellow fever. Instead, most blamed a miasma or mist which hung in the jungle air. In fact, the word ‘malaria’ means bad air. As early as 1848, an Alabama physician, Dr. Josiah Clark Nott, wrote in the New Orleans Medical and Surgical Journal, that the spread of malaria and yellow fever was not explainable by any physical laws governing gases. As an afterthought, he speculated that mosquitoes might be responsible. Nobody took this idea seriously.

In the following decades, other observers, notably Alphonse Lavern in Algeria, had observed microscopic organisms wriggling around in blood samples from malaria patients. At first Lavern took these for malarial bacteria. For context, let me remind you of the major strides made in microbiology in the decades spanning the end of the nineteenth century. Such giants as Louis Pasteur working on fermentation, Robert Koch and Paul Ehrlich studying bacteria such as those

responsible for anthrax, tuberculosis, cholera and typhoid fever, made ground-breaking observations that still hold.

In 1897, Dr. Ronald Ross, an English physician working in India, proved that a certain type of mosquito absorbed a malaria-causing parasite into its salivary gland by biting a malaria victim. The parasite multiplied within the mosquito which then spread the disease by biting healthy people. For his work on uncovering the life cycle of the malarial parasite, Dr. Ross received the Nobel Prize in Medicine in 1902.

In 1899 President McKinley appointed a commission to examine the feasibility of an inter-oceanic canal. The commission was known as the Walker commission, after the Chairman, Admiral John G. Walker. * The commission compared multiple factors – climate, health, legal rights, existing franchises, the probable costs of building and operating canals in both locales – and chose Nicaragua over Panama. American businesses had long been active in Nicaragua. Its lush country attracted fruit growers, there were minerals to be found, and Nicaragua enjoyed greater political stability. Several Americans invested in Nicaragua when it became a strong contender for the canal. Among them was Cornelius Vanderbilt, who started a company that transported passengers between New York and San Francisco via Lake Nicaragua and the Nicaraguan jungle. Indeed, Vanderbilt plotted to take control of Nicaragua and make the canal the centerpiece of his business operations.

Also favoring the Nicaraguan route was France's asking price of \$100 million for its Panama holdings, the land and building rights, existing structures including houses, a hospital, and all the abandoned excavating equipment. When Phillipe Bunau-Villa, who at one point was chief engineer of the French project, learned that the U.S. was unwilling to pay more than \$40 million he persuaded the French company that would be the best offer they would receive. Not incidentally, the Walker commission had a closed meeting with President Roosevelt and was heavily lobbied by Bunau-Varilla before reversing its pro-Nicaragua position and unanimously recommending the Panama route. It remained for Congress to accept this recommendation.

As the United States prepared to take up the Canal project, Dr. William Henry Welch, a tropical medicine specialist from Johns Hopkins, strongly urged President Roosevelt to tackle the sources of disease on the isthmus before beginning construction. A New York Tribune article called attention to the appalling conditions under which the Caribbean laborers lived, essentially in rotting shanties in the swamps in and around Colón, which had not been rebuilt after the devastating 1885 fire. With sewers and plumbing non-existent, disease was rampant. Americans who visited Panama while the French were active blamed the moral decadence of the French, their failure to follow God's laws, for the high disease rates. But real causes included the impossible heat and humidity, and the torrential downpours of the rainy season. Having learned from the French experience, the American Canal Commission made solving the sanitation problem its first priority, naming Army doctor Colonel William Crawford Gorgas chief of the hospitals and sanitary works in Panama.

Since the death of Dr. Walter Reed in 1902, Gorgas was acknowledged as the outstanding authority on tropical diseases. He was forty-nine years old, a courtly, widely admired white-haired man with a sunny Alabama manner demeanor that concealed a tremendous tenacity for hard work.

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In 1901, a yellow fever epidemic had erupted in Havana, still under American occupation following the Spanish-American War of 1898. Reed, who headed the American medical corps in Cuba, thought that mosquitoes were at fault. Gorgas, Reed's colleague, was skeptical at first, but decided to test the theory by eradicating the mosquito from Havana. His methods included, 1) putting screens on windows and doors, 2) fumigating houses, 3) isolating victims, 4) placing oil on the surface of water in cisterns to prevent egg laying, and 5) replacing standing water with running water. Amazingly, in only eight months Gorgas's efforts halted the yellow fever epidemic.

Gorgas built on his Havana experience in Panama. President Roosevelt, having served in Cuba during the war, knew that American casualties from tropical diseases in Cuba widely outnumbered those from battlefield wounds. By the time Gorgas was appointed it was known that the carrier of yellow fever was a mosquito, *Stegomyia fasciata*, later known as *Aedes aegypti*. It was also known that anyone who recovered from yellow fever was permanently immune. Gorgas and his wife actually met in the hospital where both were recovering.

Gorgas was confident he could clean up Panama provided that he had the full support of the Walker Commission. But Admiral Walker thought the mosquito theory was nonsense and a waste of money. So the commission tried to hobble Gorgas' efforts by slowing the processing of purchase orders for mosquito control supplies.

Walker's ineptitude also presented problems for the chief construction engineer, John Findlay Wallace. The commission tended to sit on requisitions. Both Gorgas and Wallace complained mightily in cables to both the commission and the President. Given the constant friction between him and the administration, Wallace was removed as chief engineer. His replacement, the highly regarded John Stevens, soon left for a better paying non-governmental position. Finally, in 1907, Roosevelt appointed Colonel George Washington Goethals as chief engineer. Goethals had held a military command, was an excellent manager and would accept no more than his military salary. And he brought crucial experience with high-lift locks from his command of the construction of the Muscle Shoals Canal along the Tennessee River.

Panama or Nicaragua?

Phillipe Bunau-Varilla, a notorious self-promoter, began a major lobbying effort through a pamphlet entitled "Panama or Nicaragua?" In it, he claimed that there was an active volcano "near" the suggested path and implied that an eruption would devastate the canal. He distributed some 13,000 copies of this pamphlet, reaching every Congressman and state governor, bank presidents, ship owners, merchants, prominent publications, and hundreds of chambers of commerce. He spoke in several big cities, maintaining that to prefer Nicaragua over Panama was like balancing a pyramid on its point. These vigorous efforts and those of William Henry Cromwell, a New York lawyer/lobbyist, helped sway the congress to reconsider its earlier stance and vote to dig the canal through Panama.

In 1902, Cromwell fed the anxiety with a Nicaraguan postage stamp falsely depicting a fuming Momotombo volcano – actually 100 miles from the proposed canal path. But volcanic activity in the Caribbean had been particularly active that year. Using this pretext, Bunau-Varilla and Cromwell planted a story in the *New York Sun* reporting that Momotombo had erupted and caused a series of seismic shocks. They sent leaflets to all 90 U.S. Senators reminding them of

the volcanic threat to the Nicaraguan route. Proponents of the route denied that an eruption had occurred. Indeed, none had. But three days after senators received letters bearing the stamps, they voted for the Panama route. In time, Bunau-Varilla became wealthy and influential, gaining access to congressmen, the cabinet and the president himself.

In January, 1903, United States Secretary of State John M. Hay and Dr. Tomás Herrán of Colombia signed the Hay-Herrán Treaty. For the initial sum of \$10 million plus \$250,000 per annum, the United States would receive a renewable lease *in perpetuity* from Colombia on the land proposed for the canal. It did not pertain to the control of the canal and the right of the United States to renew the lease indefinitely. http://en.wikipedia.org/wiki/Panama_Canal_cite_note-9 The United States Senate ratified the treaty on March 14, but the Colombian Senate held out for more money.

Declaration of Independence

A long history of separatist sentiment existed between the province of Panama and Colombia's central government at Bogotá. It was no surprise when Bunau-Varilla hinted to President Roosevelt and Secretary of State John Hay, that the Panamanians were ripe for a revolt. Bunau-Varilla hoped that the U.S. would offer troops and money to support the insurgents. Roosevelt made no promises but indirectly led the Frenchman to believe that help would be forthcoming.

Late in October, 1903, armed Colombian troops gathered in Panama City, girded to put down a possible revolt. On November 2, U.S. warships blocked sea lanes to prevent more Colombian troops from coming to Panama via the Caribbean. The United States also sent 500 troops to Colón aboard the gunboat *Nashville*.

When Colonel James Shaler, superintendent of the trans-isthmus railroad heard that Colombia was sending troops to Colón, he sent all rolling stock to Panama City, preventing the Colombian troops in Colón from reaching Panama City where the rebellion was centered. Shaler held off the Colombian generals, saying there would be a slight delay before a troop train could be assembled. Meanwhile he fitted out a luxurious car to transport the generals to Panama City. Shaler thus rendered the Colombian force leaderless and ineffectual. In the meantime the appearance of the *Nashville* in Colón harbor kept the Colombians from starting a battle. This bloodless coup was the work of a few Panamanian rebels led by Dr. Manuel Amador, a doctor and statesman, who would be President of the new Republic of Panama. Other conspirators included wealthy businessmen; Herbert Prescott, Assistant Superintendent of the Panama Railroad; and Federico Boyd, son of the founding editor of the newspaper, *Star & Herald*. The rebels were aided by key interventions of Bunau-Varilla and Cromwell. Monetary bribes helped contain officers, soldiers and others representing the Colombian army and government. President Roosevelt was diplomatically silent on the question of supporting the revolution before independence was declared. But his strong desire to have a canal built was no secret nor was his impatience with the Bogotá government for trying to extort more money in exchange for their cooperation.

After some posturing by Colombian military leaders, the Panamanians declared independence on November 6, 1903. The U.S. government quickly recognized the new Republic of Panama. Also on November 6, Bunau-Varilla, now Panama's ambassador to the United States, hurriedly drafted the Hay-Bunau-Varilla Treaty, granting sovereign rights to the United States to build on

a 10 mile wide strip of land from the Caribbean to the Pacific. The terms also granted U.S. sovereignty over this Panama Canal Zone *in perpetuity*. Buneau-Varilla, a French citizen, was not authorized to sign treaties on behalf of Panama without review. Nevertheless the treaty was approved by Secretary of State Hay and by the U.S. Senate. No Panamanians participated in the negotiations. In fact a group of Panamanian revolutionaries had set out for Washington to begin negotiations but by the time they arrived the treaty had been signed and ratified. The sovereignty issue stirred Panamanian unrest almost before the ink of the treaty had dried. Those issues festered until the Torrijos-Carter Treaties in 1977 returned the former Canal Zone territories to Panama.

American Effort

The first American steam shovel dug into the Culebra Cut on November 11, 1904. Eleven months later, 2,600 men were at work. Sidings and tracks for the spoil wagons had been laid, and dredging was underway at both ends of the canal. Surveyors mapped out the area for a large dam on the Chagres River that would control flooding and create a lake that could feed water to the Gatún lock. Not until June 1906 was the decision was finally made to give the canal locks.

During the design process, none of the engineers anticipated the problem of landslides. Because of heavy rains the cross section of the canal was constantly being adjusted by moving back the upper edges of the ditch beyond their initial lines. The original layout comprised a stepwise series of narrow benches which functioned as rock catchers, alternating with short steep slopes. At the time the engineers didn't know that the underlying strata contained bands of clay and iron pyrites. The pyrites were susceptible to oxidation when exposed to the air and moisture. Thus, when the overlying material was removed and rainwater percolated through to the pyrite-bearing strata, rapid deterioration let loose landslides that filled the ditch and added to the time needed to maintain the structure of the canal.

In 1907 President Roosevelt named Colonel George Washington Goethals chief engineer of the Panama Canal. Goethals was born in Brooklyn, New York. At age 14, he entered The College of the City of New York. After three years there he won a cadetship to West Point. He graduated second in his class in 1880, earning him a commission as second lieutenant in the Army Corps of Engineers.

In his first command, Goethals led the completion of the Muscle Shoals Canal along with the design and construction of the Riverton Lock at Colbert Shoals. His superiors in Washington initially opposed his recommendation of a single lock with an unprecedented lift of twenty-six feet, and he was forced to convince the conservative army engineers of the merits of his design. The success of the Riverton Lock inspired the eventual adoption of high-lift locks elsewhere, including those for the Panama Canal. One of the most remarkable American accomplishments was constructing sections of the locks in the United States, and then transporting them to Panama for assembly on site. The locks fit perfectly. Under Goethal's leadership construction of the canal progressed much faster than anticipated – it was completed a year ahead of schedule and under budget – words we seldom hear today. Colonel Goethals received unstinted praise from visiting engineers and from the technical press worldwide. President Wilson appointed him the first Civil Governor of the Panama Canal Zone.

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Opening.

After a few trial runs the first ship to pass through the canal at its official opening on August 14, 1914, was the *Ancon*, a Panamanian Railroad steamer. This major triumph of man's genius to overcome technical problems came just at the time when unrest in Europe led to the outbreak of World War I. For a couple of weeks the mood on the American side of the Atlantic was nevertheless exuberant at the American success in completing this engineering marvel, probably the greatest engineering feat since Egypt's pyramids. Unhappily, the first years of the canal saw a continuous series of new challenges. Early in September, yet another rock slide at Culebra completely blocked the canal in a matter of minutes. Other slides the following year closed the canal for as long as seven months. Sporadic closures also occurred when the dry season shrank Lake Gatún below the level needed to operate the locks. This was remedied in 1935 by the construction of the Madden Dam which held a higher, secondary reserve of water to hold back extreme floods and feed Lake Gatún.

From 1904 until 1914 the U.S. Government paid out about \$400 million for the canal. It was not until the 1950s, forty years later, that the venture began to show a profit. According to official figures, slightly more than six thousand employees died during the American construction period, of whom about three hundred were from the United States, but this is almost certainly an underestimate. It was the most costly project ever attempted in history. Nothing like it had ever been attempted in the tropics before. Hundreds of millions of francs were invested and lost, during France's ten-year struggle. The leaders of the project, French and American, simply believed that they could do anything, that with appropriate, innovative technology they could meet any challenge.

The French attempt focused heavy criticism on the over optimism of its promoter, de Lesseps, and its failure would see his ruin and disgrace as well as financial and political disaster for France. The American project was even more controversial involving shadowy activities by political lobbyists. But it was also a vivid demonstration of a new kind of United States, casting off its historic aversion to imperialism and aggression on the international stage.

President Roosevelt was roundly criticized in the press and in Congress for what they called high handed imperialism. To defend himself, he hid behind an air of self-righteousness. At one cabinet meeting, Roosevelt complained of being victimized by bitter press denunciations, then entered into a long, formal defense of his position. When he had finished, the story goes, he looked about the table, finally fixing his eye on Elihu Root the Secretary of War. "Well," he demanded, "have I answered the charges? Have I defended myself?" Root responded, "You certainly have Mr. President. You have shown that you were accused of seduction and you have conclusively proved that you were guilty of rape."

Years later, in a 1911 speech at Berkeley, Roosevelt claimed that "...the Panama Canal would not have been started if I had not taken hold of it, because if I had followed the traditional method I should have submitted an admirable state paper occupying a couple of hundred pages detailing all of the facts to Congress and asking Congress' consideration of it. ...Fortunately, the crisis came at a period when I could act unhampered. Accordingly I took the Isthmus, started the canal and left Congress not to debate the canal but to debate me."

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