LOOKING NORTH THROUGH CULEBRA CUT, SHOWING POINT OF DEEPEST EXCAVATION
Gold Hill on the right. White line shows original conformation, 300 feet at central point above final bottom of cut.
When the canal is finally completed the total excavation will represent 242,000,000 cubic yards of rock and earth, of which 212,000,000 will have been done under American control since early in 1904. In the Culebra section, approximately 106,000,000 cubic yards will have been excavated, or practically half of the entire American work. This total has been much increased by the numerous slides which have taken place along the precipitous slopes of the Culebra section. These, however, are not a serious or lasting menace to the canal and will be removed without delaying the date of the opening of this waterway. After the canal is completed, even though they continue to some extent, the dredges will be able to keep the channel clear while the water itself will act as a resistance to further slides. To fully realize the magnitude and difficulty of the work through the Culebra section, the visitor to the canal should try either to ride or walk through it and see the shovels, spoil trains, drills, and laborers at work. The impression made upon him will never be forgotten.

The Culebra section is terminated by the Pedro Miguel locks, which, with a small earth dam about 1,104 feet long, having a concrete core wall connecting the lock and the high ground to the westward, and having its crest at an elevation of 105 feet above mean sea level, forms a small lake and bay. The locks at Pedro Miguel have only one flight, with a lift or descent of 30⅓ feet.

Two miles south of the Pedro Miguel locks are the Miraflores
locks, consisting of two flights with a combined lift or descent at mean tide of $54\frac{2}{3}$ feet. Connecting the Miraflores locks with a high ground on the other side are two dams impounding a small lake about two square miles in area, with a surface elevation of 55 feet above mean sea level. The dam to the westward will be of earth about 700 feet long with its crest 15 feet above the water. The east dam will be of concrete about 500 feet long and having a spillway with crest gates similar to those at Gatun Dam.

Both the single flight of locks at Pedro Miguel and the two flights at Miraflores are constructed and operated in the same manner as the locks at Gatun, differing from them slightly in some lesser dimensions of gates, sills, etc.

From the entrance to the lower flight of Miraflores locks, the canal proceeds at sea level with a channel 500 feet wide, 8 miles long, to the deep water contour of the Pacific Ocean. This latter point is almost directly opposite the four little islands in Panama Bay, Culebra, Perico, Flemenco, and Naos, on which are being constructed the powerful fortifications to defend the Pacific entrance.

Where the canal meets the shore line of the sea is Balboa, the Pacific terminus of the great waterway, about two miles west of
Panama City, and the site of the extensive wharves, warehouses, coal deposits, and large dry dock included in the canal plan. From Sosa Hill, just back of Balboa, out to the island of Naos, extending over 17,000 feet, a little more than 3 miles, is a breakwater constructed of the spoil brought from Culebra Cut. It will be parallel to the axis of the canal and protect it from being silted up by the waters of Panama Bay.

All along the line of the canal wherever there is a change in the direction of the channel are range lights in gracefully built light-houses that look strange, indeed, towering up through the jungle and on the land of the Isthmus away from the sea with the thought of which light-houses are always associated.

The Panama Railway parallels the canal from Colon and Cristobal as far as Gatun. From there it formerly ran all the way close to the line of the canal, but on account of the lake overflow and the slides in Culebra Cut it has been relocated for a distance of nearly 32 miles from Gatun to Pedro Miguel. At present an old section from Bas Obispo to Pedro Miguel on the west side of the canal is operated because of the necessity of reaching the towns and stations like Culebra, Empire, and Gorgona; but when the canal is completed these tracks will be
BIRD'S-EYE VIEW OF PEDRO MIGUEL LOCK AND APPROACHES

Though this view is impressive, this lock has only one lift, while Miraflares has two, and Gatun three.
removed and these towns deserted and allowed to grow up into jungle, with the main line of the road running back of the hills on the east side of the canal. This relocation obviates any necessity of bridges or crossings which might handicap the passing of vessels. The whole roadway is an example of the highest-class construction, and the main road, though limited in mileage, is operated with the skill of a great system. When it is considered that it is interlocked everywhere with all the side and switch tracks used by the canal dump trains, it is remarkable how smoothly it is run without mixups, collisions, or accidents. Its one peculiarity, compared to the roads of the United States, is its exceptionally broad or 5-foot gauge. Its rolling stock compares favorably with the best roads of the United States.

As to the time of completion and use of the canal I quote from a circular issued recently by the Commission: "While the official date of opening has been set for January 1, 1915, it is the intention to allow vessels to utilize the canal just as soon as practicable. Present indications seem to bear out the opinion * * * that this can be accomplished during the latter half of 1913, although it is too far in advance at this time to fix any definite date. Shipping interests will, however, be advised as soon as the Commission feels assured that vessels can be passed without unnecessary delay."
THE CANAL COMMISSION

Joseph B. Bishop, Secretary
Lieut.-Col. Wm. L. Steer
Col. Geo. W. Goethals, Chairman
Lieut.-Col. H. F. Hodges
Lieut.-Col. D. D. Gaillard

Maurice H. Thatcher
Col. Wm. C. Gorgas
H. H. Rousseau

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ORGANIZATION AND ADMINISTRATION

The wonderful organization and administration of the canal and the Canal Zone, which Colonel Goethals and his efficient staff have developed, is one of the most interesting features of a study of the Isthmus. This administration includes departments of construction and engineering, subsistence, quartermaster, civil administration, judiciary, law, sanitation, disbursements, examination of accounts, purchasing department, and Panama Railroad Company.

Under the head of construction and engineering there are the headquarters at Culebra, where are located Col. George W. Goethals, Chairman and Chief Engineer; Col. H. F. Hodges, Assistant Chief Engineer; and Civil Engineer H. H. Rousseau, Assistant Chief Engineer; the Central Division, with headquarters at Empire, presided over by Lieut.-Col. D. D. Gaillard, Division Engineer; the Atlantic Division, with headquarters at Gatun, presided over by Lieut.-Col. William L. Sibert, Division Engineer; Pacific Division, with headquarters at Corozal, presided over by S. B. Williamson, Division Engineer; and Mechanical Division, with headquarters at Gorgona, A. L. Robinson, Superintendent. The Subsistence Department, which has its headquarters at Cristobal, adjoining Colon, is under charge of Lieut.-Col. George T. Wilson. The Quartermaster’s Department has its headquarters at Culebra, as does the Department of Construction and Engineering. It is under the direction of Col. C. A. Devol, Chief Quartermaster.

The Department of Civil Administration, which looks after the government of the Canal Zone, has its headquarters at Ancon, with Maurice H. Thatcher head of the department. The Department of Canal Zone Judiciary has headquarters at Ancon, and there sits the Supreme Court, of which H. A. Gudger is Chief Justice, and Thomas E. Brown, Jr., and William H. Jackson, Associate Justices. Also at Ancon is the Department of Law, of which Frank Feuille is Counsel and Chief Attorney, and William K. Jackson is Prosecuting Attorney.

The Department of Sanitation, which is of great interest to every one, has its headquarters at Ancon. At the head of this is Col. W. C. Gorgas, as Chief Sanitary Officer, and Col. John L. Phillips, Assistant Chief Sanitary Officer. The Departments of
Disbursements, with Edward J. Williams as Disbursing Officer, and of Accounts, with H. A. A. Smith as Examiner of Accounts, have their headquarters at Empire, not far from Culebra. The Purchasing Department has its headquarters in Washington, D. C. At the head of this, as Chief Purchasing Officer, is Major F. C. Boggs, with A. L. Flint as his assistant. The Department of the Panama Railroad Company not only has headquarters at Colon, under J. A. Smith as General Superintendent, but general offices at 24 State Street, New York City, in charge of E. A. Drake.

The recruiting and housing of the canal forces are looked after by the Quartermasters Department. These forces are divided into the so-called "gold" and "silver" rolls. The former consists of the officials, clerical force, construction men, and skilled artisans of the Canal Commission and the Panama Railroad, nearly all of whom are Americans. The latter include the unskilled laborers, of whom the greater part are West Indians, and the lesser number Europeans largely from Spain and Italy. The standard rate of wage for the West Indian laborer is 10 cents an hour, though those who are especially skilled get from 16 to 20 cents. The major portion of the Spaniards earn 20 cents an hour and the smaller part 16 cents. The value of the constant stock of supplies carried in the general storehouses of the Commission and the Panama Railroad is approximately $4,500,000, while $12,000,000 worth of supplies are purchased annually, requiring the discharge on an average of one steamer a day.

The Subsistence Department, supplying the food, clothing, and other necessaries, does a business of about $7,500,000 annually. It has 22 general stores in the villages and camps of the Canal Zone and Panama Railroad, and it is estimated that, including both employees and their dependents, 65,000 people are daily supplied with food, clothing, and other necessaries. Aside from these stores there are operated at Cristobal cold storage, ice-making, bakery, coffee roasting, ice-cream, and laundry plants. Every day there leaves Cristobal, on the Atlantic side of the canal, at 4 o'clock in the morning, a supply train of 21 cars carrying ice, meats, other perishable food articles, and various supplies which, in turn, are distributed to the houses of the employees.
THE WORKERS
A Typical Labor Train
Pay Day
Station Scene at Cristobal
Dinner Time
Aside from the large hotel Tivoli, at Ancon, there are 18 hotels along the line of the canal for white, "gold," employees, at which good meals are served for only 30 cents each. Two hundred thousand meals are served on an average each month. The European laborers have some 16 messes, in which they pay 40 cents per ration of three meals. These messes average 270,000 meals a month. For the West Indian laborers 14 kitchens are operated, at which they receive a ration of three meals at 25 cents per ration. At these, 100,000 meals on an average are served monthly. If the visitor to the Canal Zone has time to study the subsistence and quartermaster departments, he cannot fail to find them interesting.

The enormous equipment of the canal for construction purposes includes approximately 100 steam shovels, 315 locomotives (aside from 70 of the Panama Railroad), 560 drills, 4,400 flat and dump cars (aside from 1,500 cars of the Panama Railroad), 20 dredges, 30 unloaders, 25 spreaders, 10 track shifters, 19 pile drivers, 57 cranes, 12 tugs, 70 barges, lighters, and scows, 14 launches, rock breakers, tow boats, drill boats, etc. Some of the old French machinery has been utilized, but the greater part of the equipment is American.

The average cost of dry excavation in the Central Division, including Culebra Cut, during 1911, was 63.37-100 cents per
cubic yard; for dredging in the sea-level sections, approximately 26 cents per cubic yard.

The fortifications, which will be at both entrances to the canal, will include 16-inch, 14-inch, and 6-inch rifle cannon, and 12-inch mortars of the most powerful and effective types made, aside from submarine mines. The garrison will consist of the necessary coast artillery; three regiments of infantry, with a war strength of nearly 2,000 men for each regiment; a squadron of cavalry, and a battalion of field artillery. On the Isthmus, at the present time, is a small marine and infantry garrison, whose presence is chiefly a moral influence for the maintenance of order on the Isthmus. For the construction of fortifications, $3,000,000 have been appropriated.

Each cubic yard of average rock weighs about two tons, or 3,900 pounds; of earth, about two and a half tons or 3,500 pounds; of the mixed material of the Culebra Cut, about 3,600 pounds, or approximately a two-horse cart-load. The steam shovels or dippers, each according to size, excavate from one and three-fourths cubic yards to five cubic yards. A five-cubic yard dipper when full lifts about seven tons of earth, or nine tons of rock.

This material is carried away on trains of dump and flat cars, averaging from twenty to thirty-five cars each. The average time consumed in unloading a train of flat cars is from seven to fifteen minutes; of large dump cars, fifteen to forty minutes. The record day's work for one steam shovel was 4,823 cubic yards, or 8,395 tons. In one day 333 trains have been loaded and unloaded.

The most interesting machine used in connection with unloading the flat cars is an iron spreader, which is pulled by a cable the whole length of the train, and in a few minutes throws all the material over the side of the tracks upon the slopes of the dump piles.

The civil administration of the Canal Zone, under Maurice H. Thatcher, is an interesting feature for the visitor who has time to investigate its workings. Tom M. Cooke, the well-known Chief of Division of Posts, Customs, and Revenues, has developed an administration under these heads which he holds is the best in the world, and if one investigates them under his direction he is convinced of the truth of his claim.
The school system, in charge of F. A. Gause, Superintendent, will compare favorably with the best public-school system of any State of the United States.

The police system, under Capt. C. W. Barber; the fire department, under Chief C. E. Weidman; and the public works, under Supt. M. E. Gilmore, are conducted with the highest degree of efficiency.

The justice administered in the Canal Zone is about as near perfect as it can be. Although at the present time there is no jury trial, every inhabitant of the Canal Zone feels that he is living under a just and effective system of law and order. Chief Justice H. A. Gudger has had a long experience on the Isthmus, having been United States Consul to Panama before he was appointed to the judiciary.

While in a book of this kind it has been possible only to touch most briefly upon many features of the work on the canal and the administration of the Canal Zone, it can be readily seen from the facts briefly outlined here that the Canal Zone, the engineering construction, its civil government, its sanitation, etc., present a
unique example and one of the most remarkable illustrations of high efficiency to be found in the wide world. Long live Col. Goethals and his assistants!

THE WORK OF SANITATION

The perfect sanitation of the Canal Zone is one of its wonderful features. Yellow fever has been absolutely exterminated, and malaria and other tropical fevers reduced to a minimum. Perfect sewerage and water systems have been established in Panama and Colon and at other points. Swampy districts have been drained as far as possible, and other places treated with petroleum to prevent the growth and spread of mosquitoes. The hospitals are up-to-date in every respect. All hotels and houses of employes and hospital buildings are enclosed with wire netting to keep out stray mosquitoes. The one disease which causes the greatest number of deaths, but is largely confined to the Negro population, is, strange as it may seem, pneumonia; but the cases of this are being constantly reduced. A force of 1,400 men is employed in the sanitary staff, of whom about 750 are in the two terminal hospitals at Ancon and Colon.

The present health conditions on the Isthmus compare favorably with those of the most healthful cities and districts of the United States, and the death rate is lower than in the average American city. What has been accomplished can best be appreciated by conditions and incidents which the author remembers as existing and taking place when he first went to the Isthmus, in 1904, as United States Minister. Then the whole line of the Canal Zone was overgrown with heavy jungle, up through which towered the old French machinery like black specters of the past. In neither Colon nor

INSPECTION MOTOR CAR
Left to right — Col. Hodges, Congressman Fairchild, Mrs. Fairchild, and John Barrett
Panama were there any waterworks or sewerage systems. The mosquitoes were everywhere a pest. Nearly everybody was afflicted with malaria, while yellow fever was beginning to kill off the flower of the young men who went down to the Isthmus in those pioneer days. In short, it may be said that discouragement and death were the dominant features of the situation. To make this more realistic, I can relate an experience of my own. One Saturday night I had ten young men who held responsible positions on the canal as my guests at dinner in the Legation. On the following Saturday we buried under the wet clay four of these splendid fellows — dead by the yellow fever.

For nearly two years, beginning early in 1904, Col. Gorgas and his staff valiantly battled against overwhelming odds to kill off the yellow fever mosquito and stop the dreaded disease which was decimating the ranks of the Americans and discouraging those who escaped its clutches. By instituting a strict quarantine against all vessels coming from yellow-fever infected ports, by doing away with all stagnant water, by fumigating houses wherever an occupant had been afflicted with yellow fever, and by
following other comprehensive sanitary measures, he finally won out, and now the mention of yellow fever suggests only unhappy memories of the past.

A word should be said here about the trained nurses and other women who have left good positions or good homes in the United States to make up the hospital staff or perform other duties in the Canal Zone. Most all of the praise for remarkable work done from the early days of pioneer sanitation and construction to the present has been given to the men with too little thought of the nurses in the hospitals, the female teachers in the schools, and the wives, daughters, and sisters who have accompanied and encouraged the husbands, fathers, and brothers. From early 1904, when Miss Hibbard, as their chief, came down with the first forces of nurses and inaugurated their work with notable unselfishness and administrative skill, until the present, the women of the canal staff have done their part with a courage, devotion, skill, and patriotism deserving of the highest praise. In the trying days of yellow fever not a single nurse showed the white feather and asked to be allowed to return to the United States, and many a splendid young engineer, surveyor, clerk, or other employee owed his life to the skillful nursing and careful attention received from these untiring women. No wonder that happy marriages have often resulted from these experiences.
In this connection, however, there should not be overlooked the force of quarantine officers, hospital doctors, and male attendants. Well and faithfully have they done and are doing their exacting duties. When the roll of honor is finally made up for valiant and faithful service from 1904 to 1915 a large number of the names must include men and women who began, built up, continued, and raised to a high standard, under the example and leadership of Col. W. C. Gorgas, the health hospital, and quarantine service and conditions of the Canal Zone.

Prominent among the present and veteran hard-working sanitary staff, aside from Col. Gorgas and Col. Phillips, are Major Robert E. Noble, General Inspector; Lieut-Col. Charles F. Mason, Superintendent Ancon Hospital; Dr. Wm. H. Bell, Superintendent Colon Hospital; Dr. J. C. Perry, Chief Quarantine Officer; Dr. Claude C. Pierce, Quarantine Officer, Colon; Dr. Fleetwood Gruver, Quarantine Officer, Panama; Joseph A. LePrince, Chief Sanitary Inspector, Ancon; and Dr. M. E. Connor, Health Officer, Colon.
WHAT THE CANAL MEANS

What does the Panama Canal mean? What does it mean to the United States, to Latin America, to Europe, to Asia, to Australia, and to all of the world?

These are questions which every man interested in the progress of the world cannot fail to turn over constantly in his mind.

No other great engineering undertaking in the history of the human race, not even the construction of the Suez Canal, the building of the transcontinental railways of North America, the construction of the great wall of China, has had any such effect on the power, prestige, commerce, and opportunity of one or of a group of nations as will have the Panama Canal.

For the United States and its twenty sister American Republics the formal opening of the canal will be the solemn inauguration of a great new Pan American era of commerce, friendship, and peace. In separating North from South America with a water channel it will draw them closer together in ties of better acquaintance and larger trade.

While it will bring a quickening influence to every State and part of the United States, its most immediate benefits will be first felt upon the Atlantic, Gulf, and Pacific seaboards. Gradually the interior, especially the commercial, industrial, manufacturing, and exporting sections, and later the agricultural districts, will gain both direct and indirect advantages, until the whole land realizes that a new world commercial route is in operation. Too great changes or effects, however, must not be expected to come all at once. The real and lasting benefits to the trade and commerce of the United States will come only through the process of years and the adaptation of the business interests, not only of the United States but of foreign countries, to the new conditions of the canal. There is probability that much disappointment will be experienced in many seaports of the United States that their docks and wharves are not immediately crowded with shipping after the canal is opened. It must be remembered that water routes, though freer and less restricted than rail routes, require fleets of mercantile vessels, much capital, and large actual exchange of commodities to develop them on a big scale.

Just as a new railroad built through a sparsely settled country between two cities does not begin to do the business at first which
comes to it later on through the construction of feeders, the filling up of the country, and the growth of its terminal points, so the Panama Canal, through the extension of old steamship lines, the putting on of new lines and tramp vessels, and the building up of the countries reached by them, will increase its commerce and its shipping with eventual individual benefits to each port within the limit of its influence.

Probably the greatest good to the United States from the canal will result from the cheap, short, and quick route of water communication between its Atlantic, Gulf, and Pacific seaboards. The exchange through the canal of trade and commodities between the Atlantic and Gulf States and ports on the one hand, and the Pacific States and ports on the other, should grow rapidly in quantity, volume, and value. This development should not and probably will not injure permanently the business of the transcontinental railways. On the contrary, it will so increase the prosperity, population, and business of the coast and adjacent interior States that it will develop the local trade of the railways.
and that class of through business which will not be handled by slow-going vessels.

Some simple contrasts in distances between the Panama Canal and the Straits of Magellan will show at a glance what the Panama Canal means in the relations of the Atlantic, Gulf, and Pacific seaboards of the United States. By Magellan, the distance from New York to San Francisco is 13,135 miles; by Panama, 5,262 miles, a saving of 7,873 miles, or more than twice the distance across the Atlantic Ocean. From New Orleans to San Francisco, by way of Magellan, is 13,551 miles; by way of Panama, 4,683 miles, a saving of 8,868 miles, or practically a month’s steaming of vessels averaging 12 knots an hour. Such figures need no further argument than themselves to illustrate the real significance and meaning of the canal.

While the shortening of the distance between the domestic ports of the United States is, perhaps, the most remarkable and important fact, the saving effected between the ports of the United States and others beyond its shores upon the Pacific is almost equally significant and impressive. A steamship bound from New York to Honolulu, using the Panama Canal in preference to the Magellan route, will save 6,610 miles; from New York to Wellington, New Zealand, 2,493 miles; to Melbourne, Australia, 2,770 miles; and to Yokahama, Japan, 3,768 miles. All these distances give also a large advantage to the Panama Canal over the Suez Canal route, but there is practically no choice in actual distance between the Panama and Suez routes in the steaming distance from New York to Hong Kong, China, and Manila, the capital of the Philippines. The South American opportunity is discussed in the following chapter.