BAY OF PANAMA

During February and March the moon is particularly bright, due to the clear atmosphere which prevails in the height of the dry season. On certain brilliant evenings it is possible to read in the moonlight. The cloud effects are perfect and the rainbows magnificent. One of the prettiest effects, which happens but rarely, is a rainbow at night.

THE PANAMA CANAL.

EARLY HISTORY.

Spain, England, Portugal and France have all embarked upon the work of piercing the Isthmus, either directly or by giving aid and encouragement to their representatives, and failed. The time for success had not arrived, for even if the funds with which to prosecute the work had been unlimited, the difficulties were then too great for engineering and medical science to solve.

First there was Balboa, who, driven from home by his creditors, landed on the Isthmus of Panama in 1500, where he married the daughter of an Indian chief. In 1513 he organized an expedition that crossed from the Atlantic to the Pacific afoot in twenty-three days over what is now known as the Caledonia Canal route, one of the score of projected routes that have been since advocated at various times by various persons. Old Panama, on the Pacific side, which afterwards became known as the richest city in the world of its time, was settled in 1517, and the highways from old Panama to Nombre de Dios, on the Atlantic coast, and from old Panama to Porto Bello, which were soon afterwards built, became the first regularly traveled routes across the Isthmus, over which passed all the spoils of conquest sent back to Spain from Peru. These highways, paved with stone, furnished ample facilities for the pack trains which traveled over them for many years, and to-day some parts of these roads are in good condition and can be traced for miles through the tropical vegetation in which they remain hidden and unused.

It was in those early days that the idea of a canal took birth, even while the existence of a natural strait was in doubt. A Spanish engineer, named Saavedra, one of Balboa's followers on the Isthmus, is reported to have been its first advocate, in 1517. After studying the subject for years he was about to forward his plans in 1529 to Charles V, King of Spain, when his death occurred. Surveys of the Isthmus with this object in view were ordered, but the work was reported to be impracticable, and with the tools available in those days this was certainly true. Philip II, successor to Charles V, in 1567, sent an engineer to survey the Nicaragua route, who likewise submitted a report unfavorable to the success of the work. In his perplexity Philip is said to have laid the matter before the Dominican friars, who desired to obey the King's orders, but being unable to report intelligently on such a question, after searching the Bible, quoted: "What God hath joined together, let no man put asunder."

In 1814, feeling the necessity of reviving its waning prestige in its Central American colonies, Spain entered upon, by decree, the construction of an Isthmian canal, but before any steps could be taken to carry out this purpose her Central and South American colonies obtained their independence.

All the enthusiasm of those early days in regard to the canal idea was unavailing for lack of proper tools and sufficient capital. Moreover, the old stone highways filled the requirements very well. The Atlantic terminus of the road from old Panama had been changed from Nombre de Dios to Porto Bello about 1597. This route was followed by Morgan in his raid, which resulted in the destruction of old Panama in 1671, two years after he had sacked Porto Bello.

England entered the lists with Lord Nelson and Baron von Humboldt as its representatives, who made researches and reports on the Nicaragua and other canal routes in the latter part of the eighteenth and the early part of the nineteenth centuries. Goethe's far-seeing prophecy of American settlement and control of the Pacific coast, and the necessity of an Isthmian canal as a connecting link between our east and west coasts deserves especial attention.

In 1825, President Bolivar, of the Republic of New Granada, gave a franchise for a canal at Panama to a Frenchman, Baron Thierry, who failed in raising the required capital. President Bolivar then commissioned a British engineer, Mr. J. A. Lloyd, to survey the Isthmus for either a road or canal.

While some negotiations were undertaken by citizens of the United States prior to 1830, the year 1835 really marks the entrance of the United States into the history of the canal, through a resolution introduced in the Senate by Henry Clay, in pursuance of which President Jackson commissioned Mr. Charles Biddle to visit the Isthmus and report on the availability of the different routes for interoceanic communication. Mr. Biddle proceeded to Chagres, the only available Atlantic port, thence to Cruces by boat, and to Panama by mule back. He was much impressed with the advantages and practicability of the Panama route, and afterwards visiting Bogota, with the assistance of Don Jose Obaldia, the father of the second President of the Republic of Panama, obtained a franchise to build a railroad across the Isthmus. He returned to the United States without making an examination of the Tehuantepec and other Central American routes, as he had intended. On account of the panic of 1837 the United States was not in any condition to finance an undertaking like this, and the matter was dropped.

In 1838 a concession was granted to a French company for the construction of highways, railroads or a canal across the Isthmus. The Government of France became interested, and sent an engineer, Napoleon Garella, to report on the enterprise. He advocated a canal as the only adequate means of communication across the Isthmus. The concession was, however, allowed to lapse without performing any work on account of lack of capital.

The attention of the American people was again turned to transportation via the Isthmus by the

settlement of the Northwest boundary question, by which we came into possession of Oregon, and by the Mexican war, which added California to our possessions. Communication overland to the Pacific slope was difficult and dangerous, which deflected the main current of immigration via Cape Horn. To render this newly acquired territory more accessible, lines of steamers from New York to the Isthmus and from the Isthmus to California and Oregon were inaugurated by Americans having in view the construction of a railroad as a connecting link across the Isthmus, from which they would derive the greater part of their profits.

The very advantageous concession of the Panama Railroad Company held exclusive right to construct a railroad or canal in a certain territory, which gave it complete control of the Panama route, which by subsequent modification dated for ninety-nine years from 1867.

Altogether nineteen different routes have been suggested and received more or less attention. Of these, the Tehuantepec, Nicaragua, Panama and Darien projects are the most important, and Nicaragua has been Panama's principal rival in the last thirty years.

The railroad did not meet the requirements of interoceanic communication. Representatives of France then stepped in and the Universal Interoceanic Canal Company, by which the work was performed, was organized and incorporated by Ferdinand de Lesseps in Paris in 1878. The movement in which it resulted was started by a French promoter who secured a concession from the United States of Colombia for the construction of a canal. He transferred his concession to a speculative company called the "International Civil Society of the Interoceanic Canal." De Lesseps became interested and surveys were made of the Atrato and San Blas routes, which were pronounced impracticable. Finally, the Panama route was surveyed and a concession was obtained from the Colombian Government for the construction of a canal on any part of the Isthmus, with the understanding that the company would make satisfactory arrangements with the Panama Railroad Company in case the latter's territory was invaded. De Lesseps convened a congress known as the "International Congress of Surveys for an Interoceanic Canal" in Paris in 1879, which pronounced in favor of a sea-level canal from Limon Bay to Panama Bay, at a cost of $240,000,000 and time of completion twelve years. Less than 100 delegates of the 135 were present when the sea-level resolution was passed and only 78 voted in favor of it. The Universal Interoceanic Canal Company was then formed with De Lesseps at its head. The control of the Panama Railroad was secured through the purchase of its stock at a high figure—over $18,000,000. Work was entered upon and pushed vigorously on the sea-level plan. De Lesseps' success at Suez made him a strong advocate of the sea-level type, and a majority of the delegates had been accordingly influenced in their vote on the question. The original capital of $60,000,000 was quickly snapped up, and the first two years were spent in making surveys, examinations, and other preliminary work.

The plan originally presented to the "Congress" by the promoters, Wyse and Reclus, was for a sea-level canal 28 feet deep and having a minimum bottom width of 72 feet. It included a tunnel through the continental divide at Culebra. The currents due to the difference in tides of the two oceans were to be reduced by sloping the bottom of the canal on the Pacific side. No special attention was given to the Chagres River. This plan was adopted with certain modifications and additions. A tidal lock was provided at Corozal; the Chagres River was to be regulated and controlled by diversion channels, and by a dam at Gamboa; the tunnel through the divide was changed to an open cut. Work proceeded steadily along these lines. Subscriptions for stock had been, meanwhile, called for yearly and were dwindling. In 1887 the evident impossibility of completing the work within a reasonable cost led to the substitution for the sea-level plan of one involving temporary locks, with the summit level placed above the flood line of the Chagres River, and supplied with water from the Chagres by pumping. Work was continued until 1889, when the company went into bankruptcy. A receiver was appointed and work was suspended on May 15. Over $260,000,000 had been spent and about 66,700,000 cubic yards of excavation had been accomplished, at a cost of nearly $4 per cubic yard.

The New Panama Canal Company was formed in October, 1894, and resumed operations on the canal, principally in Culebra cut, in accordance with plans recommended by a commission of engineers. This company continued to do sufficient work to maintain its franchise until all of its rights and property were transferred to the United States Government in 1904. It excavated about 11,400,000 cubic yards. During this time, also, very thorough investigations of all engineering matters pertaining to the construction of the canal were made, which have since proved of great value. The plans of this company provided a sea-level channel on the Atlantic side, about 17 miles in length, from Limon Bay to Bohio, where a dam with a flight of two locks made an artificial lake extending to Bas Obispo. The summit level from Bas Obispo to Paraiso was reached through two locks at Bas Obispo. The high-water summit level was 102½ feet above sea level. The minimum depth of water was 29½ feet and the minimum bottom width of the channel was 98 feet. the summit level placed above the flood line of the a feeder from a reservoir formed by a dam at Alhajuela on the Chagres River, about 11 miles above Gamboa. Four smaller locks were located on the Pacific side, the two middle ones at Pedro Miguel being combined in one flight, and the others being located at Paraiso and Miraflores. The locks were in duplicate, each with usable dimensions of 738 feet in length and 82 feet in width. It was contemplated at the proper time to consider the adoption of the alternative plan of making the summit cut deeper and omitting the upper level. Between Bohio and the sea two diversion channels were provided to take care of floods from the rivers that would otherwise enter the canal.

Progress having practically ceased under the new French Canal Company, on March 3, 1899, the Congress of the United States passed an act author-

izing the President to make full and complete investigations of the Isthmus of Panama with a view to the construction of a canal to connect the Atlantic and Pacific oceans.

This marks the opening of the last chapter in the construction of the Panama Canal. The commission appointed in accordance with the above act was called upon to investigate particularly the Nicaragua and the Panama routes and to report which was the more practicable and feasible, and the cost. In November, 1901, it reported in favor of the Nicaragua route, considering the demands of the New Panama Canal Company for its franchise and property more than balanced the other advantages of the Panama route. The price fixed by the French company was $109,000,000. By subsequent negotiations the price was reduced to $40,000,000, and the commission, in January, 1902, submitted a supplemental report in favor of the Panama route.

In accordance with this report, act of Congress of June 28, 1902, known since as the "Spooner Act," authorized the President of the United States to proceed with the construction of the canal, provided arrangements could be made with the Republic of Colombia for the control of the necessary right of way. In the event of failure of these negotiations the Nicaragua route was to be adopted. The law provided that the canal should be "of sufficient capacity and depth as shall afford convenient passage for vessels of the largest tonnage and greatest draft now in use and such as may be reasonably anticipated." Appropriations were made to carry out the provisions of the act, and a bond issue of $130,000,000 was authorized.

Satisfactory arrangements were completed for the purchase of the French company's rights, etc., for $40,000,000 and negotiations with the Republic of Colombia were carried on to secure other necessary rights and privileges not held by the French company. After a long delay, a satisfactory treaty was formulated, which was rejected by Colombia in 1903.

The province of Panama, an integral part of Colombia, thereupon seceded and organized an independent republic with an area of about 31,000 square miles and a population which at present is stated to be 419,000. This resulted in the negotiation of a satisfactory treaty with the new Republic of Panama, including the payment, under certain terms, of $10,000,000 by the United States to the Republic of Panama and an annual payment of $250,000 beginning nine years after the signing of the treaty. Under this treaty the United States guaranteed the independence of the Republic of Panama and secured absolute control over what is now called the Canal Zone, a strip of land about 10 miles in width, with the canal through the center, and 45 miles in length from sea to sea, with an area of about 448 square miles. The United States also has jurisdiction over the adjacent water for 3 miles from shore. To all intents and purposes it is a perpetual lease from the Republic of Panama to the United States of all governmental rights and privileges in this territory, and yet, strictly speaking, it is not United States soil, for residents therein acquire no rights of United States citizenship and have no voice in United States elections, while citizens of the Republic of Panama residing in the Canal Zone are protected in their electoral rights and are accustomed to go to Panama and Colon to vote in the Panamanian elections. The cities of Panama and Colon and a certain water frontage adjacent thereto, while within the 5-mile limit from the center line of the canal, which bounds the Canal Zone, are excluded from the Canal Zone and are considered Panamanian territory, although the United States has, under the treaty with the Republic of Panama, the right to regulate sanitary matters therein, and, if necessary to preserve order to enter those cities with armed forces and take possession of them.

There is no doubt that the United States received ample consideration for the $40,000,000 paid to the New French Canal Company.

In consideration of the $10,000,000 paid to the Government of Panama for the rights conveyed there was turned over to the United States, in addition, all public lands in the Canal Zone, amounting to about 120,000 acres. This makes the United States Government the direct owner of 70 per cent of the land in the Canal Zone, the remaining 30 per cent. being held by private owners, mostly citizens of the Republic of Panama.

The act of Congress of 1902 placed entire jurisdiction in regard to the construction of the canal in the hands of the President of the United States, the particular functions in regard thereto being exercised by a commission composed of seven members appointed in accordance with the act of Congress, presided over by one member as chairman. For convenience in administration the canal operations have been placed under the Secretary of War.

The formal transfer of the property of the French Canal Company to the United States took place on May 4, 1904, and the first two and one-half years thereafter, or until January, 1907, were devoted largely to the work of preparation, consisting of building up a suitable organization; procuring the necessary plant and equipment; combating insanitary conditions, eliminating yellow fever, and reducing malaria; reconstructing and double-tracking the Panama Railroad; improving terminal facilities and making provision for adequate and efficient transportation to the Isthmus from the United States, a large item in itself; the design and building of suitable quarters for the army of nearly 5,000 American employees and over 25,000 laborers; introducing a stable form of civil government and administration, including courts, schools, police, fire department, etc.—in other words, doing everything necessary to transform the jungle, infested with mosquitoes and various low forms of animal and vegetable life, injurious to health, into a comparatively healthful country with all the advantages and conveniences and equivalent conditions of life as regards comfort, food, and quarters, as are enjoyed by the average citizen in the United States. All of this took time and a great deal of money, but it has resulted in advancing the condition and developing the territory in question, which was practically in the same state that it was in the sixteenth

century, to the plane of twentieth century civilization—and all in two and one-half years.

Attention was early drawn to the insanitary condition of the cities of Panama and Colon, and it was soon perceived that if a pestilence should obtain a foothold in those cities it would seriously affect canal work. To eliminate this danger, Panama has been provided with substantial brick pavements, has been well sewered and furnished with a supply of wholesome drinking water. The city of Colon has been transformed from a swamp into a town likewise comparable with a city of the same size in the United States, so far as pavements, water supply, and sewers are concerned. This work has cost about $2,275,000. The cost of all this work is an obligation which the Republic of Panama assumes and will repay to the United States with interest, through water rates which are collected directly by the United States. The sanitary condition in Colon and Panama and the advantages of good pavements are an object lesson to all travelers from South and Central America which is bearing its results, and the shipments of paving brick from the United States to South America have increased as a result of this work.

The situation in the city of Colon as regards ownership of land is peculiar. It is practically all owned by the Panama Railroad under its original franchise, under the terms of which ownership was to revert to the United States of Colombia at the expiration of its franchise. This land, therefore, cannot be sold by the Panama Railroad. By the treaty of 1904 the Republic of Panama, as the successor of the Republic of Colombia, transferred to the United States all of its right accruing at the expiration of this franchise. Meanwhile the United States had purchased the Panama Railroad from the French Company. Therefore the present condition is that the United States, through the Panama Railroad, is the owner of land in Colon, but cannot, under the railroad's franchise, sell it. This land, moreover, which it owns, will, through the expiration of the franchise of the Panama Railroad in 1966, be turned over to the United States, and the condition will arise of one government owning land in a foreign country. The land is under the jurisdiction and laws of the Republic of Panama, as it is not within the limits of the Canal Zone. This situation will be easily straightened out and ultimately some disposition made of the property, which is very valuable.

TYPE OF CANAL AND ITS VALUE TO THE UNITED STATES.

Under the Spooner Act, approved June 28, 1902, the President of the United States secured the necessary concession from the Republic of Panama, purchased the rights and property of the New French Canal Company, and undertook the construction of the Panama Canal on May 4, 1904.

The canal which the President was authorized to construct was the lock type recommended by the first Isthmian Canal Commission in its report submitted November 16, 1901. This plan also provided a lake for controlling the Chagres River by a dam at Bohio, following along the plans of the New Panama Canal Company, thereby utilizing to the fullest extent the work already accomplished.

Early in the progress of the work the construction of a sea-level canal was agitated, which took such a hold on the public mind that the President convened a Board of Consulting Engineers to consider and report upon the type of canal which should be adopted. This Board consisted of thirteen members, of whom five reported in favor of the lock type for the reasons that such a canal would provide greater safety for ships and less danger of interruption to traffic by reason of its wider, straighter, and deeper channels, as well as quicker passage for large ships; the other considerations were that such a canal could be built in less time and for less money.

On June 29, 1906, the Congress authorized the construction of the lock type of canal, in accordance with the general plans of the minority of the Board, and the work has since been carried along these lines. The wisdom of the choice is clearly shown and there is no doubt as to the ultimate success of the project.

Generally speaking, employees are selected on account of their special fitness for the work in hand, and are then unhampered in their methods of securing definite results, thus bringing out to its fullest extent individual effort and brain power.

As a consequence each man has a personal interest in the work and seems imbued with the idea that the success of the enterprise depends on him. The spirit of enthusiasm and of loyalty among the canal workers strikes forcibly every one who visits the Isthmus.

The time required for completing the lock type of canal was estimated by the Board, which made its report in January, 1906, at nine years, in accordance with which the work should be completed by January 1, 1915, and this is still retained as the date for the official opening. The expectation that the locks will be completed by June 1, 1913, is dependent on the gate contract.

Assuming that all the material will slide into Culebra cut that has been estimated, so that it will have to be removed, it is estimated that this part of the cut will be finished by September 1, 1913. It is well within possibility that slides or breaks will develop, and it may be more economical to admit the water, thus getting the advantage of the back pressure, and remove the remainder by dredges, which can be passed through the completed locks.

This will be done if need be, but in any event there is nothing that can be foreseen at present which will postpone the date fixed for the official opening, with ample time for tuning up the operating machinery and to organize and train a force for the operation and maintenance of the canal by January 1, 1915.

It is stated on reliable authority that at least 18 months will be required for shipping to adjust itself to the new conditions that will exist when the canal is ready for use. Such readjustment will not be attempted until some definite announcement is made of the tolls that are to be charged and the basis for such tolls.

Much has been said and predicted as to the commercial value of the canal to the United States. In this connection it must be remembered that the commercial shipping of this country never required

the canal. The trip of the Oregon in 1898 settled the question of the advisability of constructing an Isthmian Canal, and had the canal been built at that time, thereby saving that trip around the Horn, there is no question that it would have been agreed generally that the canal, even at an expenditure of $375,000,000, was worth while.

In whatever light the Panama Canal is viewed, it will have paid for itself if in time of war or threatened war a concentration of the fleet is effected without that long, tedious, uncertain route followed by the Oregon.

It will practically double the efficiency of the fleet, and, notwithstanding the fact that we are a peaceful nation, our outlying possessions make the Panama Canal a military necessity, and it must be so recognized. From this point of view the debt should be charged to the account which necessitated its construction, and whatever revenues are derived from other sources are so much to the good. The traffic that will utilize the canal depends upon the tolls that will be charged.

Suitable coaling plants should be erected for the sale of coal to vessels touching at or passing through the canal. In addition, since oil is now used on a number of ships plying in the Pacific, such fuel should also be on hand for sale by the canal authorities.

The extensive machine shops now located at Gorgona must be moved before the completion of the canal, and they should be established in connection with a dry dock that will be needed for commercial purposes, and utilized as a revenue producer for the canal.

With properly regulated tolls, and with facilities for fully equipping, supplying, and repairing ships, the Panama route would offer many advantages and bring to it a sufficiently remunerative return to pay not only the operating expenses, but to gradually absorb the debt which the United States has incurred by its construction.

CANAL STATISTICS.

Length from deep water to deep water (miles)	50
Length from shore-line to shore-line (miles)	40
Bottom width of channel, maximum (feet)	1000
Bottom width of channel, minimum, 9 miles, Culebra Cut (feet)	300
Locks, in pairs	12
Locks, usable length (feet)	1000
Locks, usable width (feet)	110
Gatun Lake, area (square miles)	164
Gatun Lake, channel depth (feet)	85 to 45
Culebra Cut, channel depth (feet)	45
Excavation, estimated total (cubic yards)	182,537,766
Excavation, amount accomplished May 1, 1911 (cubic yards)	137,750,520
Excavation by the French (cubic yards)	78,146,960
Excavation by French, useful to present Canal (cubic yards)	29,908,000
Excavation by French, estimated value to Canal	$25,389,240
Concrete, total estimated for Canal (cubic yards)	5,000,000
Time of transit through completed Canal (hours)	10 to 12
Time of passage through locks (hours)	3
Relocated Panama Railroad, estimated cost	$9,000,000
Relocated Panama Railroad, length (miles)	47.1
Canal Zone, area (square miles)	448
Value of all French property	$42,799,826.00
Canal and Panama Railroad force actually at work (about)	35,000
Canal and Panama Railroad force, Americans (about)	5,000
Cost of Canal, estimated total	$375,000,000
Work begun by Americans	May 4, 1904
Date of completion	Jan. 1, 1915

GENERAL DESCRIPTION.

The entire length of the Canal from deep water in the Atlantic to deep water in the Pacific is about 50 miles. Its length from shore-line to shore-line is about 40 miles. In passing through it from the Atlantic to the Pacific, a vessel will enter the approach channel in Limon Bay, which will have a bottom width of 500 feet and extend to Gatun, a distance of about seven miles. At Gatun, it will enter a series of three locks in flight and be lifted 85 feet to the level of Gatun Lake. It may steam at full speed through this lake, in a channel varying from 1,000 to 500 feet in width, for a distance of about 24 miles, to Bas Obispo, where it will enter the Culebra Cut. It will pass through the Cut, a distance of about nine miles, in a channel with a bottom width of 300 feet, to Pedro Miguel. There it will enter a lock and be lowered 30 1-3 feet to a small lake, at an elevation of 54 2-3 feet above sea level, and will pass through this for about 1½ miles to Miraflores. There it will enter two locks in series and be lowered to sea level, passing out into the Pacific through a channel about 8½ miles in length, with a bottom width of 500 feet. The depth of the approach channel on the Atlantic side, where the maximum tidal oscillation is 2½ feet, will be 41 feet at mean tide, and on the Pacific side, where the maximum oscillation is 21 feet, the depth will be 45 feet at mean tide.

Throughout the first 16 miles from Gatun, the width of the Lake channel will be 1,000 feet; then for 4 miles it will be 800 feet, and for 4 miles more, to the northern entrance of Culebra Cut at Bas Obispo, it will be 500 feet. The depth will vary from 85 to 45 feet. The water level in the Cut will be that of the Lake, the depth 45 feet, and the bottom width of the channel 300 feet.

Three hundred feet is the minimum bottom width of the Canal. This width begins about half a mile above Pedro Miguel locks and extends about 8 miles through Culebra Cut, with the exception that at all angles the channel is widened sufficiently to allow a thousand-foot vessel to make the turn. The Cut has eight angles, or about one to every mile. The 300-foot widths are only on tangents between the turning basins at the angles. The smallest of these angles is 7° 36′, and the largest 30°.

In the whole Canal there are 22 angles, the total curvature being 600° 51′. Of this curvature, 281° 10′ are measured to the right, going south, and 319° 41′ to the left. The sharpest curve occurs at Tabernilla, and is 67° 10′.

Gatun Dam.

The Gatun Dam, which will form Gatun Lake by impounding the waters of the Chagres and its tributaries, will be nearly 1½ miles long, measured on its crest, nearly ½ mile wide at its base, about 400 feet wide at the water surface, about 100 feet wide at the top, and its crest, as planned, will be at an elevation

of 115 feet above mean sea level, or 30 feet above the normal level of the Lake. Of the total length of the Dam only 500 feet, or 1-15, will be exposed to the maximum water head of 85 feet. The interior of the Dam will be formed of a natural mixture of sand and clay, dredged by hydraulic process from pits above and below the Dam, and placed between two large masses of rock and miscellaneous material obtained from steam shovel excavation at various points along the Canal. The top and upstream slope will be thoroughly riprapped. The entire Dam will contain about 21,000,000 cubic yards of material.

The Spillway is a concrete lined opening, 1,200 feet long and 300 feet wide, cut through a hill of rock nearly in the center of the Dam, the bottom of the opening being 10 feet above sea level. It will contain about 225,000 cubic yards of concrete. During the construction of the Dam, all the water discharged from the Chagres and its tributaries will flow through this opening. When construction has advanced sufficiently to permit the Lake to be formed, the Spillway will be closed with a concrete dam, fitted with gates and machinery for regulating the water level of the Lake.

Water Supply of Gatun Lake.

Gatun Lake will impound the waters of a basin comprising 1,320 square miles. When the surface of the water is at 85 feet above sea level, the Lake will have an area of about 164 square miles, and will contain about 206 billion cubic feet of water. During eight or nine months of the year, the Lake will be kept constantly full by the prevailing rains, and consequently a surplus will need to be stored for only three or four months of the dry season. The smallest run-off of water in the basin, during the past 21 years, as measured at Gatun, was about 146 billion cubic feet. In 1910 the run-off was 360 billion cubic feet, or a sufficient quantity to fill the Lake one and half times. The water surface of the Lake will be maintained during the rainy season at 87 feet above sea level, making the minimum channel depth in the Canal 47 feet. As navigation can be carried on with about 41 feet of water, there will be stored for dry season surplus over five feet of water. Making due allowance for evaporation, seepage, leakage at the gates, and power consumption, this would be ample for 41 passages daily through the locks, using them at full length, or about 58 lockages a day when partial length is used, as would be usually the case, and when cross filling from one lock to the other through the central wall is employed. This would be a larger number of lockages than would be possible in a single day. The average number of lockages through the Sault Ste. Marie Canal on the American side was 37 per day in the season of navigation of 1909, which was about eight months long. The average number of ships passed was about 1½ per lockage. The freight carried was more than 30,000,000 tons. The Suez Canal passed about 12 vessels per day, with a total tonnage for the year of 15,500,000.

Dams on Pacific Side.

The water level of Gatun Lake, extending through the Culebra Cut, will be maintained at the south end by an earth dam connecting the locks at Pedro Miguel with the high ground to the westward, about 1,400 feet long, with its crest at an elevation of 105 feet above mean tide. A concrete core wall, containing about 700 cubic yards, will connect the locks with the hills to the eastward; this core wall will rest directly on the rock surface and is designed to prevent percolation through the earth, the surface of which is above the Lake level.

A small lake between the locks at Pedro Miguel and Miraflores will be formed by dams connecting the walls of Miraflores locks with the high ground on either side. The dam to the westward will be of earth, about 2,700 feet long, having its crest about 15 feet above the water in Miraflores Lake. The east dam will be of concrete, containing about 75,000 cubic yards; will be about 500 feet long, and will form a spillway for Miraflores Lake, with crest gates similar to those at the Spillway of the Gatun

The Locks.

There will be 6 double locks in the Canal; three pairs in flight at Gatun, with a combined lift of 85 feet; one pair at Pedro Miguel, with a lift of 30 1-3 feet, and two pairs at Miraflores, with a combined lift of 54 2-3 feet at mean tide. The usable dimensions of all are the same—a length of 1,000 feet, and width of 110 feet. Each lock will be a chamber, with walls and floor of concrete, and mitering gates at each end.

The side walls will be 45 to 50 feet wide at the surface of the floor; will be perpendicular on the face, and will narrow from a point 24 1-3 feet above the floor until they are 8 feet wide at the top. The middle wall will be 60 feet wide, approximately 81 feet high, and each face will be vertical. At a point 42 1-3 feet above the surface of the floor, and 15 feet above the top of the middle culvert, this wall will divide into two parts, leaving a space down the center much like the letter "U," which will be 19 feet wide at the bottom and 44 feet wide at the top. In this center space will be a tunnel divided into three stories, or galleries. The lowest gallery will be for drainage; the middle, for the wires that will carry the electric current to operate the gate and valve machinery installed in the center wall, and the upper will be a passageway for the operators.

The lock gates will be steel structures 7 feet thick, 65 feet long, and from 47 to 82 feet high. They will weigh from 300 to 600 tons each. Ninety-two leaves will be required for the entire Canal, the total weighing 57,000 tons. Intermediate gates will be used in the locks, in order to save water and time, if desired, in locking small vessels through, the gates being so placed as to divide the locks into chambers 600 and 400 feet long, respectively. Ninety-five per cent. of the vessels navigating the high seas are less than 600 feet long. In the construction of the locks, it is estimated that there will be used approximately 4,200,000 cubic yards of concrete, requiring about the same number of barrels of cement.

Electricity will be used to tow all vessels into and through the locks, and to operate all gates and valves, power being generated by water turbines from the head created by Gatun Lake. Vessels will not be permitted to enter or pass through the locks under their own power, but will be towed through by electric locomotives running on cog-rails laid on

the tops of the lock walls. There will be two towing tracks for each flight of locks, one on the side and one on the middle wall. On each side wall there will be one return track and on the middle wall a third common to both of the twin locks. All tracks will run continuously the entire length of the respective flights and will extend some distance on the guide approach walls at each end. The number of locomotives used will vary with the size of the vessel. The usual number required will be four; two ahead, one on each wall, imparting motion to the vessel, and two astern, one on each wall, to aid in keeping the vessel in a central position and to bring it to rest when entirely within the lock chamber. They will be equipped with a slip drum, towing windlass and hawser which will permit the towing line to be taken in or paid out without actual motion of the locomotive on the track.

The locks will be filled and emptied through a system of culverts. One culvert 254 square feet in area of cross section, about the area of the Hudson River tunnels of the Pennsylvania Railroad, extends the entire length of each of the middle and side walls and from each of these large culverts there are several smaller culverts, 33 to 44 square feet in area, which extend under the floor of the lock and communicate with the lock chamber through holes in the floor. The large culverts are controlled at points near the miter gates by large valves and each of the small culverts extending from the middle wall culvert into the twin chambers is controlled by a cylindrical valve. The large culvert in the middle wall feeds in both directions through laterals, thus permitting the passage of water from one twin lock to another, effecting a saving of water.

To fill a lock the valves at the upper end are opened and the lower valves closed. The water flows from the upper pool through the large culverts into the small lateral culverts and thence through the holes in the floor into the lock chamber. To empty a lock the valves at the upper end are closed and those at the lower end are opened and the water flows into the lower lock or pool in a similar manner. This system distributes the water as evenly as possible over the entire horizontal area of the lock and reduces the disturbance in the chamber when it is being filled or emptied.

The depth of water over the miter sills of the locks will be 40 feet in salt water and 41 1-3 feet in fresh water.

Owing to the slight difference in lifts at the locks, the time of filling and emptying will vary somewhat at the several places, but the average will be about fifteen minutes, without opening the valves so suddenly as to create disturbing currents in the locks or approaches.

The time required to pass a vessel through all the locks is estimated at 3 hours; one hour and a half in the three locks at Gatun, and about the same time in the three locks on the Pacific side. The time of passage of a vessel through the entire Canal is estimated as ranging from 10 to 12 hours, according to the size of the ship, and the rate of speed at which it can travel.

Excavation.

The total excavation, dry and wet, for the Canal, as originally planned, was estimated at 103,795,000 cubic yards, in addition to the excavation by the French companies. Changes in the plan of the Canal, made subsequently by order of the President, increased the amount to 174,666,594 cubic yards. Of this amount, 89,794,493 cubic yards were to be taken from the Central Division, which includes the Culebra Cut. In July, 1910, a further increase of 7,871,172 cubic yards was made, of which 7,330,525 cubic yards were to allow for slides in Culebra Cut, for silting in the Chagres section, and for lowering the bottom of the Canal from 40 to 39 feet above sea level in the Chagres section. These additions increased the estimated total excavation to 182,537,766 cubic yards. Active excavation work on a large scale did not begin until 1907, when 15,765,290 cubic yards were removed. In 1908, over 37,000,000 cubic yards were removed, and in 1909, over 35,000,000, making a total for the two years of over 72,000,000 cubic yards, or a monthly average for those two years of 3,000,000 cubic yards. In 1910, over 31,000,000 cubic yards were removed, the monthly average exceeding 2,600,000 cubic yards. The total for these three years was nearly three-fifths of the entire excavation for the Canal. Records of all excavation to May 1, 1911, are appended:

By French Companies		78,146,960
French excavation useful to present Canal		29,908,000
By Americans—		
Dry excavation	84,112,947	
Dredges	50,976,485	
		135,089,432
May 4 to December 31, 1904	243,472	
January 1 to December 31, 1905	1,799,227	
January 1 to December 31, 1906	4,948,497	
January 1 to December 31, 1907	15,765,290	
January 1 to December 31, 1908	37,116,735	
January 1 to December 31, 1909	35,096,166	
January 1 to December 31, 1910	31,437,677	
January 1 to May 1, 1911	11,343,456	

EXCAVATION BY DIVISIONS.

May 4, 1904, to May 1, 1911.

Divisions	Amount excavated		Remaining to be excavated	
Atlantic—				
Dry excavation	8,001,503	31,548,718	271,551	11,808,627
Dredges	23,547,215		11,537,076	
Central—				
Culebra Cut	62,814,749	74,576,048	21,371,975	22,548,970
All other points	11,761,299		1,176,995	
Pacific—				
Dry excavation	3,322,902	31,625,754	3,057,240	10,429,649
Dredges	28,302,852		7,372,409	
Grand totals		137,750,520		44,787,246

Slides.

There are in all twenty-one slides along the Culebra Cut. Twelve cover areas varying from one to forty-seven acres, and nine cover areas of less than one acre each, making in all a total of one hundred and forty-nine acres. The largest is the Cucaracha slide, on the east side of the Canal, which covers an area of forty-seven acres, and which has broken back 1,820 feet from the center line of

the Canal. This slide, according to French records, started as early as 1884, and has given the Americans considerable trouble since they began work. Over two million cubic yards have been removed by the Americans, and the slide is still active. The next largest slide is a combination of two slides on the west side of the Cut at Culebra, just north of Contractor's Hill, covering about twenty-eight acres. Over two million cubic yards have been removed from this slide, and it is estimated that one million cubic yards are still in motion. On the east side of the Cut, north of Gold Hill, is another large slide covering an area of about seventeen acres which has broken back 1,200 feet from the center line of the Canal. Over 416,000 cubic yards have been taken out of this slide and about three-quarters of a million more are still in motion. The total distance across the Cut at this point from back to back of slides is 1,950 feet. In all, over nine million cubic yards have been taken out since July, 1905, because of slides, and over three million cubic yards are still in motion.

Breakwaters.

Breakwaters are under construction at the Atlantic and Pacific entrances of the Canal. That in Limon Bay, or Colon harbor, extends into the bay from Toro Point at an angle of 42° 53′ northward from a base line drawn from Toro Point to Colon light, and will be 10,500 feet in length, or 11,700 feet, including the shore connection, with a width at the top of fifteen feet and a height above mean sea level of ten feet. The width at the bottom will depend largely on the depth of water. It will contain approximately 2,840,000 cubic yards of rock, the core being formed of rock quarried on the mainland near Toro Point, armored with hard rock from Porto Bello. Work began on the breakwater in August, 1910, and on May 1, 1911, the fill had been extended 4,214 feet. The estimated cost is $5,500,000. A second breakwater has been proposed for Limon Bay, but this part of the project has not be formally acted upon. The purpose of the breakwaters is to convert Limon Bay into a safe anchorage, to protect shipping in the harbor of Colon, and vessels making the north entrance to the Canal, from the violent northers that are likely to prevail from October to January, and to reduce to a minimum the amount of silt that may be washed into the dredged channel.

The breakwater at the Pacific entrance will extend from Balboa to Naos Island, a distance of about 17,000 feet, or a little more than three miles. It will lie from 900 to 2,700 feet east of and for the greater part of the distance nearly parallel to the axis of the Canal prism; will vary from 20 to 40 feet in height above mean sea level, and will be from 50 to 3,000 feet wide at the top. It is estimated that it will contain about 18,000,000 cubic yards of earth and rock, all of which will be brought from Culebra Cut. It is constructed for a two-fold purpose; first, to divert cross currents that would carry soft material from the shallow harbor of Panama into the Canal channel; second, to insure a more quiet harbor at Balboa. Work was begun on it in May, 1908. On May 1, 1911, it had been constructed for a distance of 13,000 feet.

The Canal Zone.

The Canal Zone contains about 448 square miles. It begins at a point three marine miles from mean low water mark in each ocean, and extends for five miles on each side of the center line of the route of the Canal. It includes the group of islands in the Bay of Panama named Perico, Naos, Culebra, and Flamenco. The cities of Panama and Colon are excluded from the Zone, but the United States has the right to enforce sanitary ordinances in those cities, and to maintain public order in them in case the Republic of Panama should not be able, in the judgment of the United States, to do so.

Of the 448 square miles of Zone territory, the United States owns the larger portion, the exact amount of which is being determined by survey. Under the treaty with Panama, the United States has the right to acquire by purchase, or by the exercise of the right of eminent domain, any lands, buildings, water rights, or other properties necessary and convenient for the construction, maintenance, operation, sanitation, and protection of the Canal, and it can, therefore, at any time acquire the lands within the Zone boundaries which are owned by private persons.

Value of the $40,000,000 French Purchase.

A careful official estimate has been made by the Canal Commission of the value to the Commission at the present time of the franchises, equipment, material, work done, and property of various kinds for which the United States paid the French Canal Company $40,000,000. It places the total value at $42,799,826, divided as follows:

Excavation, useful to the Canal, 29,708,000 cubic yards	$25,389,240.00
Plant and material, used and sold for scrap	2,112,063.00
Buildings, used	2,054,203.00
Surveys, plans, maps and records	2,000,000.00
Land	1,000,000.00
Panama Railroad Stock	9,644,320.00
Clearings, roads, etc.	100,000.00
Ship channel in Panama Bay, four years' use	500,000.00
Total	$42,799,826.00

Canal Force, Quarters and Supplies.

The Canal force is recruited and housed by the Quartermaster's Department, which has two general branches, labor and quarters, and material and supplies. Through the labor and quarters branch there have been brought to the Isthmus 43,432 laborers, of whom 11,797 came from Europe, 19,448 from Barbadoes, the balance from other islands in the West Indies and from Colombia. No recruiting is required at present, the supply of labor on the Isthmus being ample.

On May 1, 1911, the total force of the Isthmian Canal Commission and Panama Railroad Company, actually at work, was divided as follows:

	Gold	Silver	Total
Isthmian Canal Commission	4,540	23,592	28,132
Panama Railroad Company (proper)	467	3,639	4,106
Panama Railroad Relocation	121	2,201	2,322
Panama Railroad Commissary	219	800	1,019
Totals	5,347	30,232	35,579

The gold force is made up of the officials, clerical force, construction men, and skilled artisans of the Isthmian Canal Commission and the Panama Railroad Company. Practically all of them are Americans. The silver force represents the unskilled laborers of the Commission and the Panama Railroad Company. Of these, about 4,500 are Europeans, mainly Spaniards, with a few Italians and other races. The remainder, about 25,000, are West Indians, about 3,700 of whom are employed as artisans, receiving 16, 20, and 25 cents, and a small number, 32 and 44 cents, an hour. The standard rate of the West Indian laborer is 10 cents an hour, but a few of these doing work of an exceptional character are paid 16 and 20 cents. The larger part of the Spaniards are paid 20 cents an hour, and the rest 16 cents an hour.

The material and supply branch carries in eight general storehouses a stock a supplies for the Commission and Panama Railroad valued approximately at $4,500,000. About $12,000,000 worth of supplies are purchased annually, requiring the discharge of one steamer each day.

Food, Clothing and Other Necessaries.

The Canal and Panama Railroad forces are supplied with food, clothing and other necessaries through the Subsistence Department, which is divided into two branches—Commissary and Hotel. It does a business of about seven million five hundred thousand dollars per annum. The business done by the Commissary Department amounts to about $6,000,000 per annum, and that done by the hotel branch to about $1,500,000 per annum.

The Commissary system consists of 22 general stores in as many Canal Zone villages and camps along the relocated line of the Panama Railroad. It is estimated that with employees and their dependents, there are about 65,000 people supplied daily with food, clothing, and other necessaries. In addition to the retail stores, the following plants are operated at Cristobal: cold storage, ice making, bakery, coffee roasting, ice cream, laundry and packing department.

A supply train of 21 cars leaves Cristobal every morning at 4 a. m. It is composed of refrigerator cars containing ice, meats and other perishable articles, and ten containing other supplies. These are delivered at the stations along the line and distributed to the houses of employees by the Quartermaster's Department.

The hotel branch maintains the Hotel Tivoli at Ancon; and also 18 hotels along the line for white gold employees at which meals are served for thirty cents each. At these 18 hotels there are served monthly about 200,000 meals. There are sixteen messes for European laborers, who pay 40 cents per ration of three meals. There are served at these messes about 270,000 meals per month. There are also operated for the West Indian laborers fourteen kitchens, at which they are served a ration of three meals for 27 cents per ration. There are about 100,000 meals served monthly at these kitchens. The supplies for one month for the line hotels, messes and kitchens cost about $85,000; labor and other expenses about $17,500. The monthly receipts, exclusive of the revenue from the Hotel Tivoli, amount to about $105,000.

Capacity of Steam Shovels and Dirt Trains.

There are several classes of steam shovels engaged in excavating work, equipped with dippers ranging in capacity from 1¾ cubic yards to 5 cubic yards, and a trenching shovel, which has a dipper with a capacity of ¾ of a cubic yard.

Each cubic yard, place measurement, of average rock weighs about 3,900 pounds; of earth, about 3,000 pounds; of "the run of the cut," about 3,600 pounds, and is said to represent about a two-horse cart load. Consequently, a five cubic yard dipper, when full, carries 8.7 tons of rock, 6.7 tons of earth, and 8.03 tons of "the run of the cut."

Three classes of cars are used in hauling spoil—flat cars with one high side, which are unloaded by plows operated by a cable upon a winding drum, and two kinds of dump cars, one large and one small. The capacity of the flat cars is 19 cubic yards; that of the large dump cars, 17 cubic yards, and that of the small dump cars, 10 cubic yards. The flat car train is ordinarily composed of 20 cars in hauling from the cut at Pedro Miguel, and of 21 cars in hauling from the cut at Matachin. The large dump train is composed of 27 cars, and the small dump train of 35 cars.

The average load of a train of flat cars, in hauling the mixed material known as "the run of the cut," is 610.7 tons (based on a 20-car train); of a train of large dump cars, 737.68 tons, and of a train of small dumps, 562.5 tons.

The average time consumed in unloading a train of flat cars is from 7 to 15 minutes; in unloading a train of large dump cars, 15 to 40 minutes; and in unloading a train of small dump cars, 6 to 56 minutes. The large dump cars are operated by compressed air power furnished by the air pump of the locomotive, while the small dump cars are operated by hand.

The record day's work for one steam shovel was that of March 22, 1910, 4,823 cubic yards of rock (place measurement), or 8,395 tons. The highest daily record in the Central Division was on March 11, 1911, when 51 steam shovels and 2 cranes equipped with orange peel buckets excavated an aggregate of 79,484 cubic yards, or 127,742 tons. During this day, 333 loaded trains and as many empty trains were run to and from the dumping grounds.

Relocated Panama Railroad.

The new, or relocated line of the Panama Railroad is 47.1 miles long, or slightly shorter than the old line. From Colon to Mindi, 4.17 miles, and from Corozal to Panama, 2.83 miles, the old location is used, but the remaining 40 miles are new road. From Mindi to Gatun the railroad runs, in general, parallel to the Canal, and ascends from a few feet above tide water elevation to nearly 95 feet above. At Gatun the road leaves the vicinity of the Canal and runs east along the valley of the Gatun River to a point about 4½ miles from the center line of the Canal, where it turns southward again and skirts the east shore of Gatun Lake to the beginning of Culebra Cut, at Bas Obispo. In this section there are several large fills, occurring where the line crosses the Gatun Valley and near the north end of Culebra Cut, where the line was located so as to

furnish waste dumps for the dirt from the Canal. Originally it was intended to carry the railroad through the Culebra Cut on a 40-foot berm, 10 feet above the water level, but the numerous slides have made this plan impracticable and a line is now being constructed around the Cut, known locally as the Gold Hill Line. Leaving the berm of the Canal at Bas Obispo, the Gold Hill Line gradually works into the foot hills, reaching a distance from the center line of the Canal of two miles opposite Culebra; thence it runs down the Pedro Miguel Valley to Paraiso, where it is only 800 feet from the center line of the Canal. This section of the line is located on maximum grade of 1.25 per cent. compensated, and has a total length of 9⅜ miles. The sharpest curve on the whole line is 7°. From the south end of Culebra Cut at Paraiso, the railroad runs practically parallel with the Canal to Panama, with maximum grade of 0.45 per cent. Where the railroad crosses the Gatun River, a bascule steel bridge is to be erected, and a steel girder bridge, ¼ mile long, with 200-foot through truss channel span, is in use across the Chagres River at Gamboa. Small streams are crossed on reinforced concrete culverts. Near Miraflores, a tunnel 736 feet long has been built through a hill. Total cost of new line is estimated at $9,000,000.

Canal Appropriations and Expenditures.

APPROPRIATIONS.

Payment to the New Panama Canal Company	$40,000,000.00
Payment to Republic of Panama	10,000,000.00
Appropriation, June 28, 1902	10,000,000.00
Appropriation, December 21, 1905	11,000,000.00
Deficiency, February 27, 1906	5,990,786.00
Appropriation, June 30, 1906	25,456,415.08
Appropriation, March 4, 1907	27,161,367.50
Deficiency, February 15, 1908	12,178,900.00
Appropriation, May 27, 1908	29,187,000.00
Deficiency, March 4, 1909	5,458,000.00
Appropriation, March 4, 1909	33,638,000.00
Deficiency, February 25, 1910	76,000.00
Appropriation, June 25, 1910	37,855,000.00
Private Act. Relief of Elizabeth G. Martin	1,200.00
Private Act. Relief of Marcellus Troxell	1,500.00
Private Act. Relief of W. L. Miles	1,704.18
Private Act. Relief of Chas. A. Caswell	1,056.00
Appropriation, March 4, 1911	45,560,000.00
Total	$293,566,928.76

CLASSIFIED EXPENDITURES TO APRIL 1, 1911.

Department of Construction and Engineering	$108,841,789.99
Department of Construction of Engineering—Plant	8,581,385.30
Department of Sanitation	12,775,053.94
Department of Civil Administration	4,714,030.52
Panama Railroad, Second Main Track	1,125,766.28
Panama Railroad, Relocating Line	6,331,631.48
Purchase and Repair of Steamers	2,657,384.88
Zone Water Works and Sewers	4,365,053.09
Zone Roadways	1,512,869.34
Loans to Panama Railroad	3,247,332.11
Construction and Repair of Buildings	9,949,267.23
Purchase from New Panama Canal Company	40,000,000.00
Payment to Republic of Panama	10,000,000.00
Miscellaneous	4,127,106.76
Total	$218,228,670.92

The balances carried in expenditure accounts, which are included in the last item above, for water works, sewers and pavements in the cities of Panama and Colon amounted altogether to $2,146,695.52. The unexpended balance in the appropriation for sanitation in the cities of Panama and Colon, available for expenditures on water works, sewers and pavements was $334,965.56, including transfer of appropriations for quarter ended March 31.

Equipment.

CANAL SERVICE.

Steam Shovels:		
105-ton, 5 cubic yard dippers	14	
95-ton, 4 and 5 cubic yard dippers	32	
70-ton, 2½ and 3 cubic yard dippers	35	
66-ton, 2½ cubic yard dippers	7	
45-ton, 1¾ cubic yard dippers	10	
26-ton	1	
Trenching shovel, ¾ cubic yard dipper	1	
Total		100
Locomotives:		
American:		
106 tons	99	
105 tons	39	
117 tons	20	
		158
French:		
20 tons	5	
26 tons	46	
27 tons	9	
30 tons	42	
Decauville	10	
		112
Narrow gage, American, 16 tons	33	
Electric	12	
		45
Total		315
Drills:		
Mechanical churn, or well	265	
Tripod	295	
Total		560
Cars:		
Flat, used with unloading plows	1802	
Steel dumps, large	600	
Steel dumps, small	1200	
Ballast dumps	25	
Wooden dumps	12	
Steel flats	500	
Narrow gage	200	
Motor	6	
Pay Car	1	
Total		4,346
Spreaders		25
Track shifters		10
Unloaders		30
Pile drivers		19

Dredges:		
French ladder	7	
Dipper	3	
Pipe-line	7	
Sea going suction	2	
Clam shell	1	
Total		20
Cranes		57
Rock breaker		1
Tugs		12
Tow boat		1
House boats		2
Clapets		11
Pile driver, floating		1
Crane boat		1
Barges, lighters and scows		70
Launches		14
Cutters		3
Drill boats		2

PANAMA RAILROAD.

Locomotives (oil burners, 12)		70
Cars:		
Coaches	57	
Freight	1477	
Total		1,534
Locomotive cranes		3
Pile driver, track		1
Pile driver, floating		1
Tugs		2
Lighters, steel		13

PANAMA RAILROAD.

The Panama Railroad, which is an important factor in the construction of the Panama Canal, originated from a resolution offered in the United States Senate by Henry Clay, in 1835; President Andrew Jackson appointing Mr. Chas. Biddle, Commissioner, to inspect the different routes adapted for interoceanic communication.

In 1848 Mr. Wm. H. Aspinwall, Mr. Henry Chauncey and Mr. Jno. L. Stephens secured a concession from the Government of New Granada tc construct the road.

In 1849 a charter was secured from the New York Legislature, and in May, 1850, work was started at what is now known as Manzanilla Point, Colon, under the direction of Mr. J. C. Troutwine and Mr Baldwin.

The road, after perplexing difficulty, was completed through to Panama, 47 miles, on January 27th, 1855, at a total cost of $8,000,000.

At the time the road was acquired by the United States Government in 1904, the track and rolling stock was in poor condition, the latter consisting of 24 small road and 11 small switch engines, 33 passenger and 968 freight cars of various kinds and capacities, many of which were useless.

The increased traffic incident to canal work necessitated constructing additional side tracks, and 34 miles of double track, as well as increasing the rolling stock to 68 engines, 58 passenger and 1485 freight cars, the large majority of which are of modern design and capacity.

The passenger service consists of four trains north and three south, daily, except on Saturday and Sunday nights, when four additional trains are in service. These trains are equipped with large, comfortable coaches and parlor observation cars on the rear, and are hauled by oil-burning engines, making travel more comfortable than in many of the so-called "de luxe" trains in the United States. The passenger traffic is very heavy, particularly around pay days, when the total number of passengers carried has exceeded 24,000 in one day. With this heavy traffic, 98 per cent. of passenger trains are on time.

The freight traffic, exclusive of material for the Canal and railroad construction work, is handled over the road at night, so as to expedite the prompt handling of canal construction trains hauling spoil from the Culebra Cut to the various dumps along the Canal and to Gatun dam. The average monthly tonnage of commercial freight amounts to over 130,000 tons.

The largest traffic of the road consists of spoil trains, which are operated during the day for a period of eight hours only, moving both north and south from Culebra Cut. The maximum number of trains handled at any one point in eight hours has been 196 trains. In addition to the numerous spoil trains, the material for the Canal work, which is handled over the Panama Railroad, amounts to almost 700,000 tons annually.

The most important and interesting train operation is the subsistence or supply train service, which supplies the 36,000 Canal and Railroad employees with the necessaries of life. This service requires two trains daily, made up of 16 to 18 cars each, consisting of refrigerator and other specially constructed cars, by which bread, meat, ice, vegetables, groceries and provisions of all kinds, as well as laundry, dry goods and other wearing apparel, is distributed to all employees daily. These trains leave the cold storage and commissary plant at Cristobal early each morning, making deliveries over the entire road, so that all employees are supplied with ice, meat and other provisions before 7:00 A. M. These trains have been operated for over four years, and, barring floods and washouts, they have been on time during the entire four years, except on two or three occasions, due to accidents.

After the completion of the Canal, the present Railroad will be under water and a new road is being constructed, skirting the edge of Gatun Lake at an almost uniform elevation of 5 feet above the Lake level.

SANITATION IN THE CANAL ZONE.

The stegomyia, the mosquito which transmits yellow fever, is a mosquito which infests cities and towns and the dwelling houses of man. It breeds principally in rain-water barrels, cisterns, wells, house gutters, etc.

It has been proved that malaria is carried from person to person by the bite of the female of a particular species of mosquito, namely, the anopheles; it is said to be conveyed in practically no other way.

The mosquito work consists in doing away with all breeding places of the stegomyia calopus; that

is, screening and covering every water receptacle in the cities so that mosquitoes cannot breed. Fumigation of every house in Colon and Panama was effective in decreasing the number of mosquitoes.

Malaria being transmitted by the anopheles mosquito, it was endeavored to stamp out this disease by entirely different methods. The female anopheles lays her eggs (about 100 at a time) on the surface of fresh water in which grass and algæ are abundant. These eggs float around until hatched by the sun's heat, and the young larvæ flee to the grass and algæ for protection from small fish and other natural enemies. After larval and pupal stages in the water, lasting about eight days, they develop into full-grown mosquitoes. The adult is weak in flight and does not habitually move about much—probably one hundred yards is practically its ordinary flight. The adult avoids the wind and seeks for its protection undergrowth, grass and plants near the ground.

All the breeding places are destroyed within one hundred yards of the locality it is desired to protect, so that the mosquito can find no water in which to lay her eggs, or in which her larvæ can develop. At the same time the brush is cleared off within the same area, so that the adult cannot secure protection against the wind.

Subsoil tiling makes the ideal anti-malarial draining system; it does away entirely with mosquito breeding, and, after it is once laid in, no further expenditure is necessary in keeping the ditch open. In the tropics the growth of vegetation is so rapid that a superficial ditch has to be cleaned out every two weeks to keep the channel free from breeding places. This is a very heavy expense, and it is found more economical to concrete all superficial ditches.

All water containers in towns, including cisterns and barrels, are also carefully looked after. In addition to this, oiling is done in the suburbs.

The Canal Zone, between Colon and Panama, was divided into some seventeen districts and a sanitary inspector placed in charge of each district. His duties were to attend to the general sanitary work of his district, look out for the proper care of night-soil, disposal of garbage, ditching, and draining for anopheles work, the stegomyia work around houses, isolating and screening for yellow fever, etc.

The result has been that the Isthmus is now almost free from mosquitoes of all kinds. This was unexpected. It was hoped by the sanitary methods to get rid of the disease-carrying mosquitoes, namely, the stegomyia and anopheles, which do not fly far; but it was not expected that the culex variety, which is strong on the wing, would be affected to any great extent.

It is thought that the Sanitary Department has successfully accomplished the object with which it started in 1904—the control of yellow fever and malaria. There still is, of course, malaria on the Isthmus. The Department has not been as entirely successful with malaria as with yellow fever. There have been no cases of yellow fever originating anywhere on the Isthmus for more than five years.

It seems that yellow fever will entirely disappear within this generation, and that the next generation will look upon yellow fever as an extinct disease having only a historic interest. They will look upon the yellow fever parasites as we do on the three-toed horse—as an animal that existed in the past, without any possibility of reappearing on the earth at any future time.

DEPARTMENT OF CIVIL ADMINISTRATION.

The work of the executive branch of the Zone Government, or the Department of Civil Administration of the Canal Commission, comprehends the Division of Posts, Customs and Revenues; Police and Prisons; Schools; Fire Protection; Public Works, and the offices of the Treasurer and the Auditor of the Canal Zone. The judicial branch includes the Supreme Court, Circuit Courts, and District Courts.

Posts, Customs and Revenues.

This Division includes the postal, customs and internal revenue services, rental of public lands, the custody of land records, and the administration of estates of Americans dying on the Isthmus in the service of the Commission or the Panama Railroad. There are now 17 post offices and 2 branch offices. Sixteen are money order offices. The value of stamps sold per annum amounts to about $80,000; the value of money orders issued per aanum amounts to over $5,000,000.

The customs service of the Zone includes the entry and clearance of ships at the ports of Cristobal and Ancon, the signing and discharge of seamen, the enforcement of Panama tariff laws against merchandise arriving at Canal Zone ports destined for Panama, and the enforcement of the Chinese exclusion law. No custom duties are collected, as no goods are imported at Ancon and Cristobal except those necessary and convenient for the construction of the canal and for the use of employees of the Commission, fuel for sale to vessels, and goods in transit.

The internal revenue service includes the collection of the tax on the distillation of liquor, the issuance of saloon licenses and other licenses, and the collection of taxes provided for by ordinance in the Canal Zone.

Postage stamps used in the Canal Zone are Panama postage stamps purchased from Panama at 40 per cent. of their face value and surcharged with the words "Canal Zone," in consideration of which the United States domestic rates of postage for letters apply between the Zone and the Republic of Panama to and from the United States.

The Canal Zone comprises an area of approximately 448 square miles. About 245 square miles are owned by the United States under the terms of the Treaty and by purchase from the French Canal Company and other private owners. At the time the land was acquired from the French Canal Company much of it was under lease. The leases were continued in force by the Commission, and other leases have been executed from time to time. Lots for building purposes in towns are now rented by the Commission at rates ranging from 5 to 30 cents per square meter per annum, while agricultural lands are rented at $3.00 per hectare per annum.

Police Force.

On June 2, 1904, the Governor of the Canal Zone authorized the organization of a police force, which

has since been increased from time to time, and at present consists of 1 chief, 1 assistant chief, 2 inspectors, 4 lieutenants, 8 sergeants, 20 corporals, 117 first-class policemen and 116 policemen, a total of 269. All are Americans except the policemen, who, for the most part, are natives of the British West Indies who have served in the British Army, and who are of special value in the maintenance of order in the Zone among the people of their own race.

In addition to the general maintenance of order and protection of property, the police have charge of the Zone penitentiary at Culebra and the local jails throughout the Zone (in which prisoners awaiting trial and those serving misdemeanor sentences are held), and act as deputy marshals, court bailiffs, deputy coroners, guards on passenger trains, pay cars and at post offices, and in some instances as watchmen at shops, storehouses, railroad crossings and hospitals.

Fire Department.

In October, 1905, the Commission authorized the establishment of a Fire Department for the Zone. On December 1 a fire chief was appointed. In November, 1906, the first paid company, composed of experienced firemen from the United States, was established at Cristobal. The organization now consists of 7 paid companies and 19 volunteer companies.

Electrical fire alarm telegraph systems have been installed at Cristobal, Gatun, Gorgona, Empire, Culebra and Ancon. The equipment of the paid company at Cristobal consists of a steam fire engine, a chemical engine, a hook and ladder truck, and two hose wagons. Each of the other paid companies is equipped with a two-horse hose wagon. The volunteer fire companies are equipped with hose reels.

Division of Public Works.

This Division operates and maintains the water, sewer, and paving systems in the cities of Panama and Colon, and also operates the water and sewer systems for the native towns in the Canal Zone. The operation of public markets at Pedro Miguel, Paraiso, Culebra, Las Cascadas, Tabernilla, Gatun and Cristobal, and slaughter houses at Empire and Gorgona also comes under this Division.

The Superintendent of Public Works is also charged with the duty of recommending the construction of roads and trails in the Canal Zone and the improvement of the streets of the native towns. Little had been done to open roads and trails throughout the Zone when the canal work began in 1904. The old paved trails built by the Spaniards were practically impassable, and a few trails leading from the railroad to interior villages of the Zone, from which the vegetation was cut from time to time, were little used except in the dry season. Since then about 60 miles of trail have been cleared, about 20 miles of which were practically graded and drained and provided with light bridges. About 35 miles of macadam road have been constructed, and about 7 miles are in course of construction. In addition, the streets in the villages of Empire and Gorgona have been macadamized and provided with concrete curbing and drains, and systems of water works and sewers have been installed and public latrines have been built in those and many other towns. Both local (misdemeanor) and felony prisoners are used on this work, and much of it has been done by them. All this work is in addition to the roads, waterworks and sewers constructed by the Commission from funds appropriated by Congress, for use directly in the construction of the canal.

Treasurer and Auditor.

The Treasurer is the custodian of the revenues of the Canal Zone, and the Auditor audits the accounts of collecting and disbursing officials of the Canal Zone Government.

Disbursing Department.

The Disbursing Department has charge of all matters pertaining to the securing, disbursing and collection of money for the Canal work on the the Isthmus, paying all vouchers and pay rolls, either at the main office at Empire, the branch offices at Ancon and Cristobal or from the pay car.

Payments on the work are made from the pay car which runs on the 12th, 13th and 14th of each month. The disbursements on the Isthmus at the present time amount, in round numbers, to $30,000,000.00 a year, $1,600,000.00 being paid for salaries and wages to officials and employees on the pay rolls of the various departments and $900,000.00 for material, supplies, etc., each month.

The pay rolls for the various departments are made up in the division offices, and, together with a pay certificate for each man borne thereon, are forwarded to the Disbursing Office, where the pay rolls are checked and the pay certificates validated and returned to the originating offices for delivery to the payees. About 34,000 names appear on the various pay rolls each month.

In addition to the above the Disbursing Office has charge of and distributes to the various issuing clerks all commissary and hotel coupon books and meal tickets.

SCHOOLS.

The school organization comprehends a superintendent directly responsible to the Head of the Department of Civil Administration; two assistants and twenty-seven principals responsible to the superintendent, and a white and colored division. The teachers are white and colored, and are paid as follows: Class 4, $50; Class 3, $60; Class 2, $90, and Class 1, $110. Supervisors are paid from $1,600 to $2,000.

The school facilities are excellent, the buildings are well adapted to tropical conditions, the rooms are all of standard size, equipped with sanitary adjustable steel desks, boards, maps and sanitary toilets. The school at each building is organized on the plan of ward schools in the city systems of the States. Free text books and free medical inspection are provided. Not only is free inspection had, but free treatment at the hospital is provided children who are found defective. Not a single instance is recorded in which a parent has refused to follow the advice of the examining physician.

The small size of many of the communities has made proper grading a difficult problem. As in the States, free transportation was found to be the only remedy. Children are transported by brake from Corozal and Balboa to Ancon, from Las Cascadas to Empire, from Paraiso to Pedro Miguel, and from Colon Beach to Cristobal. Others are carried by rail. The arrangement makes practicable a well graded system of schools, a thing toward which the Division of Schools has striven since its first organization.

Heretofore there has been high schools at Culebra, Gatun and Cristobal. These were consolidated, and pupils are now being carried by rail to Gatun, where the consolidated high school has been permanently located. A special school coach is provided for this purpose, and children so transported are supervised by a teacher especially appointed for that purpose.

All of the high school teachers are college graduates of more than two years' successful experience. Pupils are now being prepared for Chicago, Vassar, Harvard and Wellesley, and there is assurance of special recognition by some of the leading educational institutions of the States.

The organization of school gardens for colored children has been a feature. Gardens have been established at five places. Of these the Empire garden is the largest and most important. Here thirty enthusiastic boys and girls have been at work with good results to themselves in an educational way and with excellent returns in a material way. They now have a garden of flowers, tomatoes, peas, beans, okra, lettuce, turnips, mustard, yams, pumpkins, cabbage, bananas, papayas, and what not. At the close of the school year the superintendent's report showed that this garden alone had yielded $350 worth of garden products, from a plot which is less than three-quarters of an acre in size.

At first the children manifested little interest in the work, but when an early and bountiful harvest assured a reward for their labors they took hold with a right good will. The question now is how to control their enthusiasm rather than how to arouse it.

The enrollment consists of over 1,000 white and 1,500 colored children.

CHURCHES.

The Commission, in order to encourage the development of church work on the Isthmus, appointed some dozen or more chaplains to the different hospitals. These chaplains were encouraged to do work outside of the hospitals, and have gradually built up congregations everywhere along the Zone.

THE JUDICIARY.

The judicial system of the Canal Zone consists of a Supreme Court composed of a Chief Justice and two Associate Justices. Each of these justices is ex-officio a circuit court judge, and presides in one of the three circuits of the Zone. An appeal lies from one of the Supreme Court judges, acting as a circuit judge, to the other two en banc.

The Supreme Court has original and appellate jurisdiction. Its original jurisdiction is to issue writs of mandamus, certiorari, prohibition, habeas corpus, and quo warranto, and its appellate jurisdiction is to pass upon all matters appealed from the circuit courts.

The jurisdiction of the Circuit Courts is as follows:

1st. Where the subject of litigation is not capable of pecuniary estimation.

2nd. Where the title or possession of real estate, or any interest therein, or the legality of any tax, impost, or assessment, is in controversy.

3rd. In all cases in which the demand, exclusive of interest, or the value of the property in controversy, amounts to $100.00 or more.

4th. All maritime jurisdiction.

5th. In all matters of probate, and appointment of guardians, trustees and receivers, and in all actions for the annulment of marriage, and in all special cases and proceedings as are not otherwise provided for.

6th. In all cases involving the exercise of eminent domain.

7th. In all criminal cases in which the penalty of more than thirty days' imprisonment, or a fine exceeding $100.00, may be imposed.

8th. Jurisdiction to issue injunctions, mandamus, certiorari, prohibition, quo warranto and habeas corpus, in the respective circuits; and to fix, approve and accept bail in criminal cases. The Circuit Courts also have appellate jurisdiction over all cases arising in the District Courts and appealed therefrom. The Circuit Courts meet as follows: The First at Ancon, the Second at Empire, and the Third at Cristobal, at each of which places there is a court house and a clerk.

There are five district judges on the Canal Zone, and the jurisdiction of these comprise misdemeanors, and, in addition, preliminary jurisdiction in felony cases. In civil matters they have jurisdiction in all matters of contract where the amount involved does not exceed $100.00, and also in forcible entry into and unlawful detainer of lands or buildings.

The Supreme Court holds regular meetings on the second Mondays of January, April, July and October of each year, and continues in session until the business is disposed of. The Circuit Courts meet in their respective circuits one each week, and continue in session until the business is disposed of. The District Courts are in session each day. The business of the courts of the Canal Zone is despatched with great celerity. Outside of capital cases, the life of a felony case is an average of about three weeks; that is to say, from the time the crime is committed until the final decision is given by the Circuit Court, the average is the period above named. In capital cases the average is somewhat longer, but not in excess of two months.

The Supreme Court was organized June 1, 1905, with F. Mutis Duran as Chief Justice. On January 1, 1909, the term of F. Mutis Duran having expired, H. A. Gudger was appointed as Chief Justice.

The civil law which was in force in the Republic of Panama on February 24, 1904, and which has not been repealed or modified, is still in force in the Canal Zone. Since that date, however, a Code of Civil Procedure has been enacted, and various changes made by executive orders, to the extent that

the laws in force in the Canal Zone are largely modeled after those of the various States of the Union.

In criminal matters there was put in force by the Americans, immediately after their occupation, a Criminal Code, which is complete within itself, and which is modeled after similar codes in the States.

Formerly all deeds and registerable papers were registered in the circuits where the land or property existed, but at present the registry office is consolidated and papers are now registerable only by the Clerk of the Circuit Court at Ancon.

SUBSISTENCE DEPARTMENT.

The Subsistence Department is divided into two branches—Commissary and Hotel. It does a business of about seven million five hundred thousand dollars per annum. The proportion of business done by the Commissary Department amounts to about six million dollars per annum, and the proportion of business done by the Hotel Branch is about one million five hundred thousand dollars per annum.

Hotel Branch.

This Branch maintains the Tivoli Hotel at Ancon, and also twenty hotels for white gold employees at which meals are served for 30 cents each. There are served monthly about 200,000 meals.

There are seventeen Messes for European laborers, who pay 40 cents per ration of three meals. There are served at these Messes about 270,000 meals per month.

There are also operated for the West Indian laborers sixteen kitchens, where they are served a ration of three meals for 27 cents per ration. There are 97,800 meals served monthly at these kitchens.

The supplies for one month for the three classes of services cost about $84,600.00; labor and other expenses about $17,600.00.

The monthly receipts, exclusive of the revenue from the Tivoli Hotel, amount to about $107,000.00.

Commissary Department.

This Branch consists of twenty-two general stores in as many Canal Zone villages, and camps along the relocated line of the Panama Railroad. It is estimated that with employees and their dependents, there are about 65,000 people supplied with food, clothing, and other necessaries. In addition to the retail stores, there are operated the following plants: Cold storage, ice-making, bakery, coffee roasting, ice-cream, laundry and packing department.

The plants, warehouses and offices of this department are located at Cristobal.

There are about twenty-one car-loads of supplies delivered along the line daily, eleven of these being refrigerator cars used to transport ice, meats and other perishable articles. This train starts from Cristobal at 4:30 a. m., and reaches the end of its journey at 7 o'clock every morning.

As an idea of the quantities of foodstuffs that it takes to supply this vast number of people, the consumption in the fiscal year ending June 30th, 1910, of some of the most impotrant items was as follows:

Groceries.

Peas and beans in bulk	1,128,792	lbs.
Cocoa	109,504	"
Sugar	3,612,768	"
Tea	80,965	"
Baking powder	39,922	"
Salmon	162,960	"
Preserved fruit in syrup in tins	766,623	"
Jams, jellies and preserves in glass and tins	195,199	"
Meats, canned	675,852	"
Milk, evaporated and condensed	2,221,032	"
Tomatoes in tins	677,278	"
Pork and beans in tins	77,586	"
Peas and beans in tins	471,452	"
Pickles and sauces	169,460	"
Lard	420,110	"
Other vegetables in tins	524,069	"
Codfish	597,516	"
Pickled fish	27,250	"
Flour	5,363,574	"
Rice	1,629,558	"
Cereals not otherwise specified	412,429	"
Biscuits	364,982	"
Confectionery	188,319	"

Meats and Dairy Products.

Fresh meats	5,229,306	lbs.
Cured and Pickled Meats	1,046,029	"
Cheese	114,192	"
Eggs	502,950	doz.
Butter	471,551	lbs.
Poultry	429,575	"
Fresh milk	41,901	gals.
Fresh cream	22,900	"

Fresh Vegetables.

Potatoes, white	4,586,967	lbs.
Potatoes, sweet	638,584	"
Onions	717,557	"
Turnips	122,632	"
Beets	26,059	"
Carrots	91,830	"
Cabbage	656,905	"
Yams	424,789	"
Other vegetables, including celery, tomatoes, squash, and other Northern seasonable vegetables	622,484	"

Fresh Fruits.

Apples	526,472	lbs.
Peaches	63,944	"
Pears	21,780	"
Plums	17,706	"
Grapes	54,066	"
Oranges	236,854	doz.
Lemons	13,574	"
Grapefruit	11,837	"
Limes	5,493	"
Cantaloupes	59,724	only.
Watermelons	10,845	"
Other fruits	26,276	lbs.

QUARTERMASTER'S DEPARTMENT.

Organization.

Chief Quartermaster.
Assistant Chief Quartermaster.
Depot Quartermaster.
Constructing Quartermaster.
Eleven District Quartermasters.
Eleven Assistant District Quartermasters.
Six Storekeepers.

Total gold employees	221
Total silver employees	3,113
Grand total	3,334

The Quartermaster's Department was organized in July, 1908, under the direction of the Chairman, by Colonel Devol, who arrived on the Isthmus July 1, 1908.

The organization was accomplished by consolidation of Departments as follows:

July 15th.—Labor and quarters of the Department of Labor, Quarters and Subsistence.

September 1st.—Material and Supply Department.

September 1st.—Grass cutting and disposal of night soil and garbage from the Sanitary Department.

October 1, 1909.—Physical accountability system for all Isthmian Canal property, with audit by the Chief Quartermaster.

July 1, 1909.—Building and Construction Department.

The work of the Quartermaster's Department as it is now in operation is summarized as follows:

1st.—Recruits all unskilled labor for the work.

2nd.—Assigns, furnishes, and is in charge of all Commission quarters.

3rd.—Performs sanitary work relating to grass-cutting, removal of night soil and garbage.

4th.—Constructs and repairs all Isthmian Canal Commission buildings.

5th.—Requisitions and distributes supplies for the Isthmian Canal Commission.

6th.—In charge of scrapping French material.

7th.—Audits all property returns pertaining to the Isthmian Canal Commission.

The administration of the various Districts by District and Assistant District Quartermasters, is an evolution from the administration of an Army Post. In each case the Quartermaster attends to all the material wants of the community, except food supplies. The Commissary stores are, however, delivered by the Quartermaster's Department.

Each District has a small working force of artisans, utility men, janitors, etc., to attend to the wants of the District. Each District has also a corral, with sufficient animals and vehicles for local needs.

There are 500 mules and 100 horses in the general corral system, which supplies the entire Canal Zone with team service. The Quartermaster's Department supplies the various construction divisions and departments, including drivers, for $3.50 per day; single animals at $1.00 per day. This amount is not an actual transfer of money; it is credited to the corral service as a revenue. In other words, this department stands in the light of a contractor for all team service on the Isthmus.

This department also furnishes the brake service to the trains in the various districts where the distance from the houses to the stations is considerable. Gatun, Culebra, Paraiso, and, to a certain extent, Ancon has this service. A rather extensive brake service is furnished for conveying school children from Colon Beach to the school at Cristobal; Las Cascadas to Empire, and from Corozal to Ancon. Brakes are also used for various official parties which visit the Zone.

The gold employees are quartered in bachelor quarters and married quarters. Both quarters are furnished by the Government, and fuel, light and water are supplied without charge. These allowances amount to about $40.00 per month for married employees, and $14.00 per month for bachelors. All quarters are screened and furnished with modern plumbing.

All assignments are made by the District Quartermaster, in accordance with an established code of rules, based on date of application, rate of salary, and date of entry in the service. The rules have now stood the test of time, and very few complaints are received.

The silver employees are housed in what are known as barracks, accommodating 72 men each. The barrack system is modelled directly from the U. S. Army Transport plan.

The Building and Construction Department is organized with a small force in each District; also with what are known as Traveling Gangs—four carpenter gangs and three painting gangs.

There are 3,218 buildings on the Canal Zone pertaining to the Isthmian Canal Commission, which have cost, to date, $11,159,743.04.

The estimate for the current year for new construction is only $50,000.00, as it is believed that the houses now erected should be made to answer for all purposes to complete the Canal.

Although buildings deteriorate rapidly in this climate, the repairs to buildings during the last year has been held down to about $250,000.00, which, it will be noted, is less than 2½% of the valuation of the buildings. The buildings are all generally uniform in construction plan and painted the same color throughout.

Material and supplies for the work on the Canal, requisitioned through the Quartermaster's Department, amounts to about $11,000,000.00 annually, and the stock on hand at all the Storehouses to about $4,500,000.00.

This large stock is necessary owing to the fact that the Isthmus is about 2,000 miles from the source of supply; also to the fact that it is required to carry a complete stock of railway supplies, steam shovel supplies, electrical supplies, with all the diversified handling plants on the Isthmus. The Price Book of the Department, therefore, carries more than 20,000 items, and requirements necessitate at least a three months' supply on hand.

The Storehouse system begins at Mt. Hope, known as the Quartermaster's Depot. The accountability for all property is initiated at Mt. Hope, where the United States bills are certified. From Mt. Hope to the line Storehouses the material is handled by a system of invoices and receipts.

There are six Storehouses outside of Mt. Hope. They are all sectionalized on the same general plan,

by letter Sections A, B, C, etc.; Section A carrying the same class of material in all Storehouses, etc. All local requisitions are, therefore, sectionalized and are sent to the proper section of the issuing Storehouse.

This system of Storehouses under one management permits of an interchange of stores to the end that excess stock in one store and depleted stock in another is overcome.

Under the adopted system, material matters pertaining to an annual appropriation of more than $40,000,000.00 are successfully taken care of, and more than 37,000 employees, of three distinct nationalities, are housed and made contented and comfortable.

During the last two years ornamentation of the grounds has been carried on systematically by gardeners, under the District Quartermasters. A propagating garden is established at Empire, from which the plants are distributed. As all vegetable life grows luxuriantly in the tropics, very encouraging results have been obtained at a minimum cost, and it is now an exceptional house that is not surrounded with flowers and plants. In this endeavor to beautify the grounds and make conditions seem home-like, the department has been very materially assisted by the active interst and personal endeavor of most of the occupants of the houses.

CLUB WORK FOR MEN OF THE CANAL ZONE

Made Possible by the Isthmian Canal Commission and Conducted by the Young Men's Christian Association.

After many urgent appeals and requests from officials at Panama, from leading business men of New York, from army and naval officers who were acquainted with conditions and needs on the Canal Zone in 1904, and after consulting with those in authority at Washington, the International Committee of Young Men's Christian Associations decided to make an investigation of the field with a view of ascertaining the conditions surrounding the men from the United States who were employed in conjunction with the work of the Canal, and of determining in what way and to what extent the Young Men's Christian Association could serve the interests of these men and the Canal Commission. Mr. J. R. Thompson, a representative of the International Committee, visited the Isthmus in December, 1904. At that time the Canal work was under the direction of Chief Engineer John F. Wallace, who met with General George W, Davis, the first Governor of the Canal Zone, John Barret, United States Minister to Panama, Colonel W. C. Gorgas, the Chief Sanitary Officer, and Mr. J. R. Thompson, of the International Committee, on December 29, 1904, for the purpose of discussing the establishment on the Isthmus of Panama of branches of the Young Men's Christian Association. The minutes of this meeting, which were submitted for the action of the Isthmian Canal Commission at Washington, by General Davis, Chairman of the Committee, showed that the entire committee was heartily in favor of the Government backing the Association in conducting a club work for men on the Canal Zone.

In May, 1906, Mr. A. Bruce Minear, another secretary of the International Committee, came to the Canal Zone, with a letter to Mr. John F. Stevens, then Chief Engineer of the Isthmian Canal Commission, from Colonel Theodore Roosevelt, then President of the United States, in which Colonel Roosevelt stated that Mr. Minear was to organize the Association work on the Isthmus; that nothing better could befall the people on the Isthmus than to have these Y. M. C. A. organizations flourish as they have flourished on the railroad systems in the United States as well as in the army and navy. He further recommended that the Y. M. C. A. be given plenty of space to establish an attractive, wholesome, decent club for young men; a club where the prayer meeting would come in as an adjunct to reading rooms, bath rooms, billiard rooms, bowling alleys, etc. Colonel Roosevelt further expressed the hope "that all that the Government can do to help along this work will be done."

The first clubhouse was opened by the Isthmian Canal Commission under the management of the Young Men's Christian Association in May, 1907. Three others were opened by July of the same year. These first four clubs were built at the following places: Culebra, Empire, Gorgona and Cristobal. Associated with the General Secretary, there were four Secretaries, one for each Association. In September, 1907, Mr. F. C. Freeman was sent from New York to act as Traveling Secretary of the Zone. A little later four Assistant Secretaries were added to the force.

Upon the resignation of Mr. Minear, Mr. Freeman was appointed General Secretary of the Y. M. C. A. and Superintendent of Club Houses, in December, 1909. In the Spring of 1910 Colonel George W. Goethals, Chairman and Chief Engineer of the Isthmian Canal Commission, caused to be constructed, at Gatun and Porto Bello, Commission Clubhouses, placing same under the management of the Y. M. C. A. In the Spring of 1911 a seventh building was constructed and opened at Corozal.

The work carried on by the Y. M. C. A. on the Canal Zone compares very favorably with Association work in the States. The strongest feature of the work is social, yet the educational, spiritual and physical phases of the work have in no way been neglected. The social work consists of entertainments brought from the States as well as local dramatic, musical, minstrel and vaudeville productions. Bowling, both local and inter-association; billiards and pool, chess and checkers; library of from 800 to 1,000 volumes; reading rooms where may be found from 75 to 100 of the best magazines, newspapers and periodicals; writing tables for the use of members; refreshment counters where ice cream, light lunches and all soft drinks can be secured.

The educational work has consisted of classes in Spanish, English, mathematics, mechanical drawing, history, air brakes and first aid courses.

The religious work conducted by the associations has consisted of Bible Clubs, Discussion and Life Problem Clubs, mid-week services where it has proven advisable, and Sunday afternoon or evening services, wherever such services have not conflicted with the regular church service. The Association has made it a strong point in its policy to endeavor to

co-operate with the church work and help build it up rather than to endeavor to carry on an independent religious campaign and by so doing weaken both the Church and the Association.

Taking into consideration the fact that the Canal Zone is only about 9 degrees north of the Equator, the physical work that has been carried on is phenomenal. Inter-association basket ball and indoor base ball leagues are conducted during the year, outdoor athletic meets have created a great deal of interest among the members, while regular weekly gymnasium classes are conducted in all the Associations.

The membership dues are $10.00 annually; $6.00 semi-annually and $4.00 quarterly. The membership is subject to fluctuation in accordance with reduction or transfer of the working force. During the past year it has ranged between 1,800 and 2,200.

The Isthmian Canal Commission not only made this club work on the Canal Zone possible by constructing and equipping the seven clubhouses, but the Commission goes further and spends a considerable amount of money each year for supplies, salaries of secretaries and janitor force, miscellaneous equipment and repairs. The membership dues and fees of the members are used in keeping up the activities and in helping defray other expenses.

Statements have been made by men in a position to know, that this club work has meant more to the successful carrying on of the work of the Panama Canal than can ever be reckoned in dollars and cents. It has helped to make the men and women happier and more contented, and has always stood for the highest and noblest in the lives of the men, women and children on the Canal Zone.

THE I. C. C. PRINTING PLANT.

The Printing Plant of the Isthmian Canal Commission is attached to the Quartermaster's Department, and is under direct supervision of Mr. William M. Garrett. Prior to May, 1909, the Commission printing and stationery department was located in the old administration building in the City of Panama, and the Panama Railroad operated an office of their own in Colon. To facilitate the work and reduce the cost of production, the present location at Mount Hope was decided upon and the offices consolidated.

The "Canal Record," the official organ of the Commission, is published weekly from this plant, also the printing and stationery used by the Canal Zone courts and schools are distributed from here. The character of the work is diversified and peculiarly unique from a publisher's viewpoint, as it embodies three classes of printing, seldom, if ever, carried on by a single publishing house, not excepting the United States Government Printing Office at Washington, D. C., viz: Municipal, Railroad and Federal printing. Aside from the foregoing, the amount of general publishing accomplished each year would pay a good dividend to a large publishing establishment in the States.

The plant is modern in every particular, and the twenty power presses, ruling and typesetting machines are taxed to their utmost capacity at all times. The entire mechanical force, with the exception of the supervisory positions, consists of Spaniards and negroes from the West Indies.

Space will not permit of our dealing at length with this interesting branch of Uncle Sam's canal building, but suffice to say that it is established on the same monumental and economical basis that marks the entire management of this great work in a country where the climate and environments are at such variance with American custom.

CAMP ELLIOTT.

Ever since the occupancy of the Canal Zone, the United States Government has maintained a military force on its Isthmian territory, consisting of United States Marines. In 1903, there were 1400 officers and enlisted men stationed at various places along the Zone. These were under the command of Brigadier General George F. Elliott (now Major General, retired), from whom the present camp gets its name. The services of the Marines have been required on three occasions: in 1904, when an attempt was made against the administration of President Amador; in 1906, during the Panama elections, and again in 1908 during the Panama elections. On none of these occasions, however, was it necessary for the Marines to take active part, although they were encamped in close proximity to the City of Panama and ready for instant service.

One battalion has been located at Camp Elliott since 1904, but additional forces in 1906 and 1908 were commanded by Lieutenant Colonel (now Colonel) James E. Mahoney and Lieutenant Colonel Eli K. Cole, respectively. From December, 1909, to April, 1910, a brigade under the command of the present Major General, Commandant, W. P. Biddle, (then Colonel) was encamped at Camp Elliott and at Las Cascadas, because of the revolution in Nicaragua.

The force on duty at the present time consists of one battalion of four companies under the command of Major Smedley D. Butler. The enlisted strength is 444.

The camp is located on an elevated site close to the Canal and but a short distance from the town of Bas Obispo.

THE ISTHMUS AS A TOURIST RESORT.

Apart from the interest every one has in the Panama Canal, the visitor to the Isthmus will find much to occupy his time in the manifold interests outside of the Canal Zone.

First of all, the change that has taken place in regard to sanitary conditions must be emphasized, and the healthy condition of the Isthmus is remarkable. It is true that for several hundred years it has borne an unsavory reputation, but that was prior to the advance in science which removed the cause of the disease—the mosquito.

The mean temperature for the Isthmus is about 80 degrees Fahrenheit. The year is sharply divided into two seasons, dry and rainy, the latter lasting from April to December. The heaviest rains usually occur in November. Hence, it will be seen that the most desirable time to visit the Isthmus is in the dry season, although many pleasant days in succes-

sion are experienced in the height of the rainy season. As in all tropical countries, it rains in torrents but soon clears and within the cities especially hardly an evidence of a shower are to be seen shortly after.

The Isthmus where the canal pierces it is scarcely fifty miles across and visitors always make their headquarters at either Colon, Ancon or Panama City. At all of these places splendid hotels are in operation. Frequent trips may be made to Gatun, to inspect the locks, dam and spillway; to Culebra, where an excellent view of the Cut may be had, and to Pedro Miguel or Miraflores to see the locks.

Porto Bello, Nombre de Dios and Fort San Lorenzo are places of historic interest on the Atlantic side.

Old Panama, on the Pacific side, and but a few miles from Panama City, is worthy a visit. A good carriage road now extends to the town, or the trip may be taken across the bay in a small boat. At the entrance to Old Panama may be seen the remains of a masonry bridge overgrown by jungle. The historic paved road to Porto Bello passes over this bridge, and it can be traced through the almost impenetrable jungle. Over this road the wealth of Peru was carried by the Spaniards centuries ago, en route to Spain.

Coastwise steamers make regular trips up and down the Pacific coast to ports leading to the interior of the Republic of Panama, where the charms of the tropics may be fully enjoyed. The islands near-by are not to be overlooked. Taboga contains much of interest with its native population and quaint customs.

Panama City may be easily considered a cosmopolitan place when it is understood that about fifty nationalities are represented within its limits. Situated as the city is, with the Far East accessible as well as the Old and New Continents, it has always been the meeting place of strange peoples, and always will be.

The town in the olden days was completely walled as a protection against pirates. The sad experience with Morgan and his raiders in the days of Old Panama taught the founders of the new town the necessity of this protection. The wall was so long and costly in building that the King of Spain asked ironically, "If he would not soon be able to see the walls from Madrid." Some of the wall may be seen to-day and in parts walked upon.

Not only are the old churches of interest, but the ruins of Santo Domingo Church, in which the famous flat arch is situated, is well worth visiting. People from all parts of the world have seen and wondered at the peculiar construction of this piece of masonry.

The traveler to the Isthmus hears much of the painted potteries and gold ornaments found in the Indian graves. The gold Huacas (of Chiriqui) are rich in archaeological interest. In the making of these relics, wonderful technique is displayed. The finds prove that the Indians, whose history is little known, understood many arts. Private collections of Ehrman & Company and Jose Misteli, while not particularly on display, are frequently shown to those who are interested.

Much of interest is to be seen around the city's streets; the mode of living of the inhabitants; the styles of costumes on gala occasions, and the quaintness of the houses.

The progressiveness of the Government is everywhere in evidence. The new National Institute, which cost about $700,000, is a step in the right direction. There is dormitory capacity for 200 students with class room for 1000—boys only. It is built in a rectangular form, with a square patio in the middle. The Institute comprises seven buildings. Two public schools have been recently completed at Colon, besides other beautiful buildings of a public character.

With the well-paved streets already made and the good, macadamized roads throughout the country, built both in the Canal Zone and within the bounds of the Republic, Panama must eventually become the Mecca for ardent automobile enthusiasts. Already a garage is established; already the wealthier Panamanians have their cars.

The hotels offer good accommodations; the people are courteous; the shops supply everything that is to be found in any market in the world; the climate is delightful, and, taking it altogether, Panama offers the tourist as many attractions as most places of resort, outside of the greatest construction enterprise of modern times—the Panama Canal.

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