

FILE ...7...
10
.....

2L
ACCESSION NO. 1916/206.

AUTHOR: Captain Hugh Rodman, U.S.Navy.

SUBJECT: Notes of a Lecture on the PANAMA CANAL - delivered
at the U.S.Naval War College, Dec. 18, 1915.

DECLASSIFIED IN DOD MEMO OF 3 MAY 1982, 8085:
DECLASSIFICATION OF WWII RECORDS

1916/206.

NOTES OF A LECTURE ON THE

PANAMA CANAL

~~TO BE~~ DELIVERED BY

CAPTAIN HUGH RODMAN, U. S. NAVY.

AT THE

NAVAL WAR COLLEGE,

NEWPORT, R. I.

On Dec. 18, 1915.

THE PANAMA CANAL.

When the President of the War College wrote requesting me to give you a talk on the Panama Canal, my first inclination was to decline for the double reason that the subject covers such a vast field, and second, that I doubted my ability to prepare and deliver a lecture that would be of even average interest or use; but on thinking the matter over, I felt it a duty to accept, but more with a view of coming before you so that you might ask questions of interest, and with the hopes that I might be able to answer some of them, or clear up doubts which may have existed on certain points in connection with problems or questions which may have arisen at the War College.

I have therefore made no attempt whatever to prepare a lecture or article for record or publication; nor have I had access to any files nor been able to procure all of the charts and pictures that I would like to have to illustrate graphically many points in a much better way than I can in words, but have simply arranged a list of subjects, with a few illustrations, and will discuss them briefly, trusting to my replies to the questions propounded after I have finished, to shed the most light on the subject.

First and foremost, in any reference to the Panama Canal, comes General Goethals and his valuable assistants, most of whom were from the Army Engineer Corps, and all of whom too much praise cannot be given, not only for undertaking and bringing to a successful finish such a gigantic enterprise, and for overcoming such a multitude of difficulties, but in planning a waterway so well adapted to its purpose in every respect.

Let anyone who is familiar with the Isthmus, go over the route of the Canal, and try for a moment to realize what he would have done, had the responsibility been on his shoulders; and he will appreciate all the more the enormous task that rested on those who were entrusted with its building.

Gatun Lock alone will stand as an eternal monument to its designer and builder, General Hodges, whom I once told jokingly, that I thought it would be more a monument to his cheek in thinking that he could do it, than to anything else.

GENERAL DESCRIPTION.

✓ **Canal Zone.**—The Canal Zone is a strip of land 10 miles wide, extending from ocean to ocean across the Isthmus of Panama, and includes in addition, all of the waters of Gatun Lake, and the land around its banks which lies within the 100-foot contour above mean sea level; the Canal runs through the center of the Zone, from Colon and Cristobal on the Atlantic side, to Balboa on the Pacific. The United States exercises sovereignty over this territory through the Governor of The Panama Canal, but the cities of Colon and Panama, and their harbors, are excluded, except as to quarantine and sanitation, and are under the control and jurisdiction of the Republic of Panama; the city of Cristobal, however, adjacent to Colon, is under the control of the United States.

Ports of Entry.—There are thus two distinct and separate ports of entry on each side; at the Atlantic end the harbor of Colon is roughly a quadrilateral with an area of about $\frac{1}{2}$ square mile off the western water front of Colon City, to the northward of Cristobal Mole, and inside and to the eastward of the dredged channel of the Canal; the remainder of the harbor is known as the port of Cristobal, and is under American jurisdiction.

On the Pacific side the port of Panama lies to the eastward of an extension of a line adjoining Gabilan Rock and Hermanos Rocks, and American jurisdiction covers the area to the westward which lies between this line and the western boundary of the Canal Zone; Balboa is the American port of entry.

✓ **Main Features, Canal, Locks, and Lakes.**—The Panama Canal does not, as is generally thought, cross the Isthmus from east to west, its general direction is from northwest to southeast, the Pacific entrance being about 23 miles east of the Atlantic entrance. It is a lake canal as well as a lock canal, its dominating feature being Gatun Lake, a great body of water covering about 164 square miles

and occupying the northern half of that portion of the Isthmus through which the Canal passes. This lake is an elevated body of water with a surface level maintained at from 85 to 87 feet above sea level by the Gatun dam and locks on the Atlantic side, and the Pedro Miguel locks and dam on the Pacific side. On both Atlantic and Pacific sides there is a dredged channel, extending from deep water in the sea up to the foot of the locks which lift vessels to the level of the lakes.

The entire length of the Canal from the entrance to the dredged channel in the Atlantic, to that in the Pacific, is 43.84 nautical miles.

A vessel bound through the Canal from the Atlantic to the Pacific will enter the dredged channel in Limon Bay, 500 feet wide and 40 feet deep at mean low water; this extends to Gatun Locks, a distance of 5.77 miles. At Gatun it will pass through three locks in series, and

be lifted 85 feet to the level of Gatun Lake, and once in the lake, there is a well-marked channel varying in width from 1,000 to 500 feet wide, and from 85 to 45 feet deep, growing gradually narrower and shoaler as the upper end of the lake is approached, where the lesser measurements are found at Gamboa.

The lake is very irregular in outline, full of islands, which, with the surrounding land, are all heavily wooded or covered with tropic vegetation. From Gatun to Gamboa, across the lake, the Canal does not run in one continuous straight line, but consists of a series of reaches, which follow, in general, the old valley of the Chagres River; at each of the bends the channel has been sufficiently widened to allow plenty of room for the largest ships to make the turn in safety.

At present, 1915, much of the timber which formerly covered the submerged land is still standing, but this is rapidly disappearing.

Floating islands have made their appearance, not only in the broader expanses of the lake, but have drifted or formed in some of the narrower reaches, and without local knowledge might be easily confused with the land. Particular attention must be paid to them when navigating the Canal after dark.

The length of Gatun Locks is 1.04 miles, and the distance to Gaillard Cut,* following the channel of the Canal is 20.55 miles. From Gatun to Gamboa the lake has covered the valley of the Chagres River, but here, the river valley is left, and Gaillard Cut is entered; it is 300 feet wide, 6.97 miles long, 45 feet deep, the whole of which, though now an arm of the lake, had to be excavated. Here the banks of the Canal are more or less sheer, and the hills, most of which show the marks of excavation, rise abruptly from the sides of the Canal.

Pedro Miguel Locks, 0.75 mile long, are at the Pacific end of Gaillard Cut; they have a single drop of $30\frac{1}{2}$ feet into Miraflores Lake.

* Formerly known as *Culebra Cut*.

This lake is made by Miraflores locks and dam, and through it there is a dredged channel 500 feet wide, 45 feet deep, and 0.86 mile long, leading to Miraflores Locks, which consists of two locks in series, 0.91 mile long, and lowers a vessel $54\frac{3}{4}$ feet, more or less, depending upon the state of the tide in the Pacific end of the Canal. From here to the sea there is a dredged channel 500 feet wide, with a depth of 35 feet at mean low water, extending past Balboa to the Pacific entrance, a distance of 6.99 miles.

All of the locks in the Canal are double, that is, there are parallel chambers, so that vessels may pass each other in the locks, going in opposite directions, if so desired. The lock chambers are uniform in size, 1,000 feet long, 110 feet wide, average roughly a lift of about 30 feet in each chamber. There are intermediate gates so that the chambers may be shortened if so desired. They are massive concrete structures, electrically controlled and illuminated, and equipped with electric locomotives on tracks, which will not only tow all vessels through the locks, but act as traveling capstans to keep them clear of the lock walls.

Depth of Canal.—A least depth of 40 feet will be maintained throughout the Canal, except in the dredged channel on the Pacific side from the entrance to Miraflores Locks, where a depth of 35 feet at mean low water will be maintained.

Towage through Locks, Chocks, Bitts, etc.—Ordinarily six locomotives will be used, two forward for towing and steadying the vessel in the lock chambers, two amidships for towing and afterwards for checking the vessel's headway, and two aft for steadying her and checking her headway.

LOCKS

General description, - Power for operating - control towers - auxiliary or hand power - rapidity of action in passing vessels - commercial vessels - battleships - auxiliaries - destroyers - submarines - plan for putting the fleet through - first auxiliaries anchor in lake, then battleships by divisions, etc. - refer to recent plan - abundance of anchorage room in lake - 2 lines 1/4 mile distant, vessels 500 yards interval - 50 vessels in one formation - 23 vessels moor near Gatun.

Time to put fleet through Canal - constricted anchorage room on Colon side inside of breakwater - plenty outside - may eventually *remove reefs* in Colon Harbor. Unlimited anchorage room on the Pacific side - safe in all weathers.

Comment, - - - - - Advantage of having the two Pacific Locks in one - cost - economy in maintenance - hard to find foundation - Congressman's jokes about lack of necessity for Pacific locks - General Goethals reply. Precautions at locks - Chief Engineer in engine room - no passengers allowed to embark or disembark - slow approach - no orders given - everything to work automatically - signals at approach walls to direct - current at the salt water ends Salt in Miraflores Lake - Change water works

*Ranges set
in middle of
channels.*

✓ **Aids to Navigation.**—The general scheme of lighting and buoying the Canal includes the use of range lights, in the longest reaches, and lighted buoys and beacons along the sides, showing red lights on one side, white on the other. There is a double range for each long reach, a head and a back range, so that a vessel going in either direction will have a range ahead. The range towers are white, cylindrical concrete structures, set a little to starboard of the axis of the Canal, so that if vessels going in opposite directions keep on their respective head ranges, they will have ample room to pass.

Lighted buoys and beacons are placed along the sides of the Canal and across Gatun Lake at intervals of a little less than one mile, and at all angles and turns; spar buoys are placed between the lighted buoys throughout the length of the Canal, except in Gaillard Cut, where the formation and well-defined steep banks render buoys of any kind unnecessary.

The range lights are all white, the front light fixed, the rear flashing; the four beacons on the Atlantic side which mark the dredged channel from the southern end of the bay to Gatun Locks, all in Gaillard Cut, and from Miraflores Locks to Balboa on the Pacific side, show fixed lights.

The beacons on the Atlantic breakwaters, in Gatun Lake, those on the west side of the channel from Balboa to seaward, and No. 6, to the northward of Balboa Harbor, and all gas buoys marking the channels of the Canal, show flashing lights.

The west breakwater beacon, Colon Harbor, shows a red flashing light; the east breakwater beacon, beacon No. 11, near Bohio in Gatun Lake, and beacon No. 21, Balboa Harbor, show flashing green lights.

Electricity and acetylene gas are the illuminants, and each aid is given the necessary intensity to make it plainly visible from whatever distance it may be necessary to see it; the gas buoys are surmounted by a steel framework 12 feet high, which gives them a focal plane of 15 feet. The Canal is so well marked by numerous aids to navigation that it would be difficult for a steamer to lose her bearings in any part of it.

The buoys are colored in accordance with the system in vogue in the United States, with red buoys on the starboard hand on entering from seaward, and black buoys on the port. The lock at Pedro Miguel is the dividing line between the Atlantic and Pacific systems; that is to

say, that after passing through the locks, red and black buoys will be found on opposite sides of the channels to those on which they were before reaching the locks.

For list of aids to navigation, see page 61.

✓ The ends of the breakwaters are lighted - 3 new lights recently erected on the Pacific side - Aids to navigation are ample.

✓ **Anchorage and Moorings for Vessels Transiting Canal.—**

Under the direction of the pilot, vessels may be permitted to anchor in Gatun Lake where the depths are sufficient outside the Canal limits, or moor to the lock walls, or to the mooring buoys at the north end of Gaillard Cut near Gamboa signal station, or in Gaillard Cut opposite La Pita signal station, or to the mooring buoys on the west side of the Canal, Balboa Harbor.

There is ample mooring room so that vessel's transit may be accurately and expeditiously timed.

Panama Railroad.—The old Panama Railroad followed the valley of the Chagres from Gatun to Gamboa, but this part is now submerged in Gatun Lake; the Canal follows very closely the route of the old railroad between these points. From Gamboa it crossed the continental divide through the present site of Culebra, thence through Paraiso, and the bed of what is now Miraflores Lake, to Panama.

When the Canal was under construction it was necessary to relocate it, and but little of its old roadbed could be utilized. It is now 47.11 statute miles long, and lies wholly to the eastward of the Canal, roughly paralleling it from one side to the other. From Gatun it follows the shore line of the lake, then crosses some of its numerous arms until Monte Lirio is reached, from which place to Darien, the site of the Government radio station, it is built mostly through the tropical forest, though it crosses some of the smaller arms of the lake between these points. From Darien to Gamboa it once more follows closely the lake shore, and at Gamboa crosses what was once the Chagres River, but is now an arm of the lake. From the Chagres River to Paraiso it leaves the Canal and crosses the continental divide through a hilly country covered with the usual tropic growth, returning once more to the Canal at Paraiso and closely parallels it to the Pacific ports.

There is frequent train service, both transisthmian and between local points; there has been a very heavy passenger and freight traffic over the road at all times, though the latter will greatly diminish now that the Canal is open to shipping.

Colon and Cristobal on the Atlantic side are connected with Panama and Balboa on the Pacific; Panama is the terminus for passenger trains, but nearly all of the freight on that side is handled at Balboa.

Since the opening of the Canal the Panama Railroad has ceased to be a competitor in handling freight consigned to ports beyond the Isthmus.

23000 bannons carried in one day

✓ **Interests of Panama Canal and Panama Railroad closely combined.**—There is a community of interest between The Canal and the Panama Railroad; the management and direction are under one head, namely, the Governor. Many of the officials and employees are common to both; they occupy the same offices, and the business of the Railroad is handled as would be that of any other department of the Canal.

In relation to shipping it furnishes coal, provisions, and supplies, but correspondence in relation to these should be sent to the Marine Superintendent, or be communicated verbally to the Captains of the Ports.

SLIDES.

Col. Leiber - different slides in the world.

Designed slopes - factor of safety - Different ones, Cucaracha, Gold Hill, Culebra, Zion Hill, small ones everywhere, large ones glacial action, motion of debris, character of debris, vegetation erect in traveling, dredging in front, hydrauling behind, - Cucaracha - not good, impracticability of using steam shovels - reason why - different kinds of dredges - depositing debris in Lake - wave motion of earth - basaltic formation and fracture - obliteration of banks as designed - also berm - Suggestions from outsiders as to best means of preventing and removing slides.

Operation, - Past slides, size of channel and vessels - trying to keep the Canal open a certain number of hours each day - slides finally conquering after a year's trial - permanent removal - prognosis - 16 vessels put through Canal in 2 hours, 16 minutes - Kroonland - Vessels passing in Culebra Cut - corner cut away to widen cut - comment - would make the Cut straighter.

THE CANAL AS A COMMERCIAL ENTERPRISE.

Number of ships originally estimated that would use the Canal - 5 per week - number actually using it when blocked - 5-1/2 per day. - Collections ran from about \$22,500 the first month to \$660,000 the last month, - Sept. 1915. General character of trade - coast-wise carrying, domestic products, sugar, canned fruit, coal, lumber, grain, other truck including nitrates. War material to Valdis-toc - and colliers supplying the allies' vessels in the Pacific including British, Australian and Japanese -

Allies probably used Panama Bay for coaling - is well adapted, etc. Neutrality of the Canal in reference to colliers - privileges and purchase coal and stores from the Government denied - but could do so from private parties - what constitutes the nearest port? All coal, stores and supplies on Isthmus practically in hands of Government. Rules and regulations for operating Canal were all written for a war basis - all commodities and services in Government hands - Private enterprises discouraged - Rules can be modified or privileges be granted in peace times - Pilots practically in control though responsibility for safe navigation rests with master.

BUSINESS METHODS.

Getting measured - Measures in different countries and different ports - Certificates - Checking certificates - Making deposit - Bills for services and supplies - Settlement of account - Keeping business in the hands of the Canal officials - Simplicity of methods - Officials and Panama R. R. act as agent.

ORGANIZATION.

Governor - Departments of maintenance - Operation - Quartermaster who is the Commissary and handles stores, supplies etc. - Panama R. R. - Sanitary or health - Auditor Civil - Terminal construction - Dredging - Mechanical - Army.

MARINE SUPERINTENDENT

Charge of operations - Everything pertaining to movements of vessels - Pilots - Tugs - Launches - Measurement of vessels - License of marine men - Signals - Radio - Tolls - Lighthouses - Aids to Navigation - Traffic has an interest in services to vessels including supplies, etc., etc.

CAPTAINS OF THE PORTS.

Executive officers of the Canal in reference to shipping, movements of vessels, canal traffic, harbor masters, etc., etc., - Officers are the center of information for all nautical affairs - Clearinghouse for all business - Branch H. O. - Cables - Bills - Investigates damage,

claims, tools, charges, etc.

TRANSIT THROUGH CANAL.

Pilots in charge - No orders - Signals at locks and elsewhere - Radio - Dispatch board - Safety the first consideration - Special communication - Tugs - Services - Supplies, etc. In case of accident or damage immediate investigation.

SUPPLIES.

Coal - Amount - Coaling plants - Food - Supplies - Fuel oil - Water - Laundry - Services of various kinds - Delivered during transit - Bills promptly rendered and settled.

REPAIRS.

General plant at Balboa - Drydock under construction/at Cristobal a smaller dock and machine shop.

TERMINAL FACILITIES.

Harbors, wharves - Coaling plants - Railroad facilities.

HEALTH.

Sanitation - Hospitals - Inspectors - Contagious diseases - Quarantine very strict - Malaria, means to arrest and prevent - Must be sent to hospital - Statistics in comparison with U. S. ports - Suspicion ward - Priest in maternity ward.

FORTIFICATIONS - DEFENSE

I do not profess to possess too much knowledge in reference to military matters nor to the principles of how any army at Panama would be handled, now to its strategy and tactics. The following notes are from my own observation and conclusions:-

Guns at each end - projected batteries on Taboga Island - Lack of torpedo defense guns. - small caliber guns on ends

of breakwaters - would have point blank fire - should be others at land entrance to Canal particularly on Atlantic side - nets projected for stopping submarines - chains for destroyers - Smoke screen on Atlantic side for destroyers - wind on shore, rain-squalls, - easy for destroyers to enter - Army mine fields - Probability of fleet being able to hit disappearing guns - hard to hit mortars - Guns Taboga would have elevation of 950 feet - hard to hit - Hostile fleet could maneuver on either side - Compare strength of guns - Pacific inadequately defended - Stations of troops on Isthmus - Defense of batteries entirely in hands of infantry - no rapid fire guns - batteries on Atlantic side easy to approach - tropic jungle - if an advantage to forts is equally so to invaders - Areas around locks cleared of vegetation -

Anti-air craft guns should be permanently emplaced in vicinity of locks - Guns not ready - Mortar breech troubles - No reserve ammunition - No co-operation or co-ordination between Army and Navy - No code of recognition signals - No strategic or tactical plans prepared nor joint exercises prepared - Why not have Atlantic Fleet attack on Atlantic Side? No common knowledge of mine fields - Pilots not informed of location of mines - No free channels through these - No plans for scouting - Scouting would have to be done by destroyers and flying machines - No flying machines on the Isthmus - When they do come there should be but one corps, and that made adaptable both to Army and Navy use - Should be secret supply stations for submarines - And small radio sets in outlying islands, bays, etc. Submarine stations proposed - Number of boats for each side - Vulnerability of locks from gun fire, aerial attack and high explosive surrepticiously placed - Lock gates - Control towers - Spillway - Machinery - Lower gates can be closed - All gates to be closed during attack - Reason why. Impracticability of wrecking both sides of the locks - Vessels or other obstructions sunk in Canal could be blown to pieces and raised by the two 250 ton cranes - Channels dredged around them - 10-foot leeway all that would be necessary - Canal approaches easy to mine particularly on Pacific - Sea must be controlled unless

emergency stores, ammunition, etc. be kept on Isthmus. - Isthmus not self-sustaining -

NEUTRALITY OF REPUBLIC OF PANAMA: Combined with that of U.S. by Presidential proclamation, no foreign nation at war with us would respect it - Would seize base in any of its waters - Pearl Islands well adapted - Can anchor anywhere on Pacific side - Bays and harbors on Atlantic side.

Rules and regulations were written from a war basis - They are now the law - Can ease up on them in times of peace as we may see fit - In times of war any army officer may be appointed governor with supreme command.

