PLAN AND OPERATION OF THE CANAL 185

It has been asserted that the abandonment of the Sosa site was in response to a new idea acted upon without due consideration. The facts in the matter are these: In 1905, the present chief engineer visited the Isthmus in the capacity of a member of the Board of National Defenses. In a relevant report, he made the following statement:

"The great objection to the locks at Sosa Hill is the possibility of their destruction by the fire from an enemy's ship. If, as has been suggested to me by officers of this department entitled to speak with authority on the subject, these locks can be located against and behind Sosa Hill in such a way as to use the hill as a protection against such fire, then economy would lead to the retention of the lake. . . . . If, however, Sosa Hill will not afford a site with such protection, then it seems to me wiser to place the locks at Miraflores."

Mature study of the question led to the conclusion that locks at Sosa would not be sufficiently secure, and it was further evident that their transfer to Miraflares would be accompanied by a saving in cost. The latter point, it should be remembered, was that decided upon by the Walker Commission for the site of the tide lock at the Pacific end. So that it appears that this, like all the other features of the plan, has been the subject of the most exhaustive investigation and thought.

CHANGES IN DIMENSIONS

The increase of channel width through one-half the length of Culebra Cut from 200 feet to 300 feet at the bottom, which will enable ships to pass each other in any part of the Cut, was not made on the recommendation of the Commission, but by executive order.

The usable dimensions of the locks were changed at the instigation of the President and on the recommendation of the General Board of the Navy from 900 feet and 95 feet, to 1,000 feet and 110 feet.
186 PLAN AND OPERATION OF THE CANAL

On this point Colonel Goethals has said: "It is objected that the size of the locks limits the Canal to vessels which can use them. This is true. The present lock designs provide intermediate gates dividing the locks into lengths of 600 and 400 feet. About 98 per cent of all ships, including the largest battleships now building, can be passed through the 600-foot lengths, and the total lock length will accommodate the largest commercial vessels now building, which, I believe, are 1,000 feet long and 88 feet beam. It is true that ships may increase in size so as to make the present locks obsolete, but the largest ships now afloat can not navigate the Suez Canal, nor the proposed sea level canal at Panama. It must also be remembered that the commerce of the world is carried by the medium-sized vessels, the length of only one of the many ships using the Suez Canal being greater than 600 feet."

It is undoubtedly fortunate that Colonel Goethals' judgment in this matter was not accepted, since during the past two years a great increase in the size of both commercial and war vessels has come about, chiefly noticeable in width. Our new battleships have a beam of 97 feet and upwards, which will leave a clearance in the lock chambers of less than 13 feet in all, or about 6 feet on either side. Commercial vessels now built, and others whose keels have been laid, have a beam of 96 feet, so that it is quite possible that the locks may prove to be too narrow before they are found too short.

The height of the Gatun Dam was decreased, so that its crest stands 30 feet, instead of 50 feet, above the normal level of the lake, which is 85 feet.

This change was made because, with the progress of time and more thorough knowledge of the foundation material, it became quite evident that the larger dimensions were unnecessary, and to build in accordance with them would be a wasteful expenditure of time and money. The reduced weight is sufficient to meet the utmost demands of stability, and the reduced height is ample for the com-
complete retention of the lake, which can never, under any conceivable circumstances, rise to 100 feet above sea level.

COST OF THE CANAL

The present estimated cost of the Canal, which it is improbable that any future conditions will materially affect, is about $375,000,000. No unknown factors, nor hypothetical calculations entered into the preparation of these figures. This estimate is largely in excess of that which formed part of the report of the Board of Consulting Engineers, but which was based on data much less complete than that since rendered available. During the last six years of the work there was an increase in the wage scale and in the cost of material. Wages on the Isthmus exceeded those in the United States from 40 to 80 per cent for the same class of labor. The original estimates were based on a ten-hour day, but Congress afterward imposed upon the Commission the observance of an eight-hour day. The various changes already noted, and others of a minor character, but considerable in the aggregate, increased the quantity of the work to be done by 50 per cent. Despite all this, the unit costs increased no more than 20 per cent. Furthermore, no such system of housing and caring for the employees as was maintained was anticipated by the Board.

In addition, municipal improvements in Panama and Colon, together with advances to the Panama Railroad, approximated $15,000,000, a sum which will eventually be returned to the Treasury of the United States.

APPROPRIATIONS

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payment to the New Panama Canal Company</td>
<td>$40,000,000.00</td>
</tr>
<tr>
<td>Payment to Republic of Panama</td>
<td>10,000,000.00</td>
</tr>
<tr>
<td>Appropriation, June 28, 1902</td>
<td>10,000,000.00</td>
</tr>
<tr>
<td>Appropriation, December 21, 1905</td>
<td>11,000,000.00</td>
</tr>
<tr>
<td>Deficiency, February 27, 1906</td>
<td>5,990,786.00</td>
</tr>
<tr>
<td>Appropriation, June 30, 1906</td>
<td>25,456,415.08</td>
</tr>
<tr>
<td>Appropriation, March 4, 1907</td>
<td>27,161,367.50</td>
</tr>
<tr>
<td>Deficiency, February 15, 1908</td>
<td>12,178,900.00</td>
</tr>
</tbody>
</table>
### 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

### Appropriation, March 4, 1911
45,560,000.00

### Appropriation, August 24, 1912
28,980,000.00

### 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

### Private Act. Relief of Alejandro Comba
500.00

### Private Act. Relief of Douglas B. Thompson
1,500.00

### Private Act. Relief of Robert S. Gill
2,520.00

**Total**
$322,551,448.76

### Appropriation for Fortifications, March 4, 1911
3,000,000.00

### Appropriation for Fortifications, August 24, 1912
2,806,950.00

**CLASSIFIED EXPENDITURES TO NOVEMBER 1, 1912**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Construction and Engineering</td>
<td>$159,411,558.14</td>
</tr>
<tr>
<td>Department of Construction of Engineering Plant</td>
<td>2,868,362.47</td>
</tr>
<tr>
<td>Department of Sanitation</td>
<td>15,319,682.40</td>
</tr>
<tr>
<td>Department of Civil Administration</td>
<td>5,961,599.68</td>
</tr>
<tr>
<td>Department of Law</td>
<td>30,887.52</td>
</tr>
<tr>
<td>Panama Railroad, Second Main Track</td>
<td>1,123,477.93</td>
</tr>
<tr>
<td>Panama Railroad, Relocated Line</td>
<td>8,866,392.02</td>
</tr>
<tr>
<td>Purchase and Repair of Steamers</td>
<td>2,680,112.01</td>
</tr>
<tr>
<td>Zone Water Works and Sewers</td>
<td>5,140,506.45</td>
</tr>
<tr>
<td>Zone Roadways</td>
<td>1,579,724.67</td>
</tr>
<tr>
<td>Loans to Panama Railroad Company</td>
<td>3,247,332.11</td>
</tr>
<tr>
<td>Construction and Repair of Buildings</td>
<td>10,188,813.63</td>
</tr>
<tr>
<td>Purchase from New Panama Canal Company</td>
<td>40,000,000.00</td>
</tr>
<tr>
<td>Payment to Republic of Panama</td>
<td>10,000,000.00</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>4,207,175.37</td>
</tr>
</tbody>
</table>

**Total**
$270,625,624.40

**Expenditures for Fortifications to Nov. 1, 1912**
1,685,315.75

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
PEDRO MIGUEL LOCKS.

The south end of the East Chamber, showing construction of safety and lower gates.
altogether to $2,395,358.79. 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 $97,465.64, including transfer
of appropriations for quarter ended September 30, 1912.

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 $42,000,000, divided as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation, useful to the Canal, 29,708,000 cubic yards</td>
<td>$25,389,240.00</td>
</tr>
<tr>
<td>Panama Railroad Stock</td>
<td>9,644,320.00</td>
</tr>
<tr>
<td>Plant and material, used, and sold for scrap</td>
<td>2,112,063.00</td>
</tr>
<tr>
<td>Buildings, used</td>
<td>2,054,203.00</td>
</tr>
<tr>
<td>Surveys, plans, maps, and records</td>
<td>2,000,000.00</td>
</tr>
<tr>
<td>Land</td>
<td>1,000,000.00</td>
</tr>
<tr>
<td>Clearings, roads, etc.</td>
<td>100,000.00</td>
</tr>
<tr>
<td>Ship channel in Panama Bay, four years' use</td>
<td>500,000.00</td>
</tr>
</tbody>
</table>

Total                                      | $42,799,826.00 |

The Canal Zone contains about 436 square miles, about
95 of which will be under the waters of the Canal and
Gatun and Miraflores Lakes. It begins at a point 3 marine
miles from mean low water mark in each ocean, and extends
for 5 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 san-
itary 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 436 square miles of Zone territory, the United
States owns about 363, and 73 are held in private own-
ship. 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. The United States will also control the area to be covered by Gatun Lake which extends beyond the lines of the Canal Zone.

The population of the Canal Zone, official census, is 62,810; of Panama City, 35,368; of Colon, 17,749.

The permanent administration and Canal headquarters building will be on a knoll west of Ancon quarry where it will overlook both the terminal piers and the Canal entrance. It is to have 75,000 square feet of floor space and is to cost not more than $375,000, including $25,000 for that part assigned to permanent records. The quarters for employees attached to the administration building will be erected in the general area adjacent to and northeast of it, and employees connected with the shops, docks, and other terminal facilities at Balboa will be housed in quarters erected in the area surrounding the slope of Sosa Hill and on the fill adjoining the Ancon-Balboa highway. There will be a permanent settlement at Pedro Miguel for employees of the Pacific locks, and one at Gatun for employees of the Atlantic locks. The settlement at Cristobal will be maintained, and possibly the settlement at Ancon. No necessity is apparent for any other than the above five settlements, except for the military forces which will be stationed on the Isthmus.

The piers for commercial use at Balboa are built at right angles to the axis of the Canal, with their ends about 2,650 feet from the center line of the Canal channel. They are about 1,000 feet long, and 200 feet wide, with 300-foot slips between, and with landings for small boats at the head of each slip for the full width between piers. The old French steel wharf, about 1,000 feet long, will be retained for some time in the future, for commercial purposes.
PLAN AND OPERATION OF THE CANAL

Two wharves and one pier have been constructed at Cristobal, behind a mole and breakwater, built out from shore toward the Canal channel, and paralleling the boundary line between Canal Zone and Panamanian waters. Primarily, these docks are to meet the commercial requirements of the Panama railroad, but should there be enough traffic after the Canal is completed to justify it, four other piers, each about 1,000 feet long, and 209 feet wide, with 300-foot slips between, will be constructed.

The main drydock will be situated at Balboa, and will be capable of accommodating any vessel that can pass through the Canal locks. It will have a usable length of 1,000 feet, a depth over the keel blocks of 35 feet at mean sea level, and an entrance width of 110 feet. The entrance will be closed by miter gates, similar to those used in the locks. The drydock will have a rock foundation, and its sides will be lined with concrete. Its equipment will include a 40-ton locomotive crane, with a travel on both sides.

For vessels of smaller type, an auxiliary drydock will be built at Balboa, in lieu of the marine railways originally contemplated. It will have a usable length of 350 feet, a width at entrance of 71 feet, and a depth over the keel blocks of 13½ feet at mean sea level. It will be provided with a floating caisson. The 40-ton locomotive crane on the main drydock will be utilized for this dock also. The work of providing space for these drydocks, as well as for the new shops, is now under way, and requires the excavation of about 300,000 cubic yards of material from the northwest face of Sosa Hill. The excavated material is used in filling the site for the shops and terminal yard.

On the Atlantic side it is proposed to retain the old French drydock at Mount Hope, which has a usable length of 300 feet, a width at entrance of 50 feet, and a depth over the sill of 13 feet at mean sea level. It was the opinion of the board in charge of the dock projects, that the commercial requirements in sight would not warrant the construction of a drydock at Cristobal capable of accommodating...
large vessels, in view of the building of a drydock at Balboa, to which any large vessel on the Atlantic side could be taken and returned, in case it was found necessary to dock it for repairs.

The plans contemplate furnishing vessels with fuel, fresh water, and supplies of all kinds. The main coaling plant will be situated on the north end of the island, opposite dock No. 11, Cristobal. It will be capable of handling and storing 200,000 tons of coal, with a possible increase of 50 per cent. One hundred thousand tons of the total normal storage is subaqueous. The plant will have railroad connection with the mainland over a bridge of the bascule type, which will cross the French canal at a point about half a mile south of the Mount Hope drydock. The preliminary work on this plant has been begun by the Panama railroad.

A subsidiary coaling plant will be situated at Balboa, at the outer end of the southeast approach wall of the drydock, having a frontage of 500 feet thereon, adapted for discharging vessels. This plant will be capable of handling and storing 100,000 tons of coal, with a possible increase of 50 per cent. Fifty thousand tons of the total normal storage is subaqueous.

In addition to coal, facilities will be provided at Cristobal and Balboa for supplying shipping, and the Canal works, with fuel oil. In line with this plan, four steel tanks of 40,000 barrels capacity each, have been contracted for in the United States.

The main repair shops will be built at Balboa, and are designed to maintain the following equipment:

1. Lock, spillway, and power plant machinery. 2. Water and land equipment retained for the maintenance of the Canal. 3. Rolling stock and equipment of the Panama railroad. 4. Mechanical apparatus connected with the coaling plants, fortifications, cold storage plant, wireless stations, etc. 5. The making of repairs, etc., required by commercial vessels, and by private individuals and corpora-
tions. 6. The making of such repairs as may be required by vessels of the United States Navy.

In addition to these, a number of subsidiary buildings will be erected. All of the structures will be of permanent construction, with steel frames. The sides and ends will be left open for ventilation and light, protection from sun and rain being afforded by overhanging sheds.

The main metal working shops, including machine, erecting and tool shops, the forge and pipe shop, and the boiler and shipfitters' shop, together with the shed for the storage of steel, will be placed end on between the drydock and repair wharf. The general storehouse, foundry, woodworking shops, subsidiary buildings, and office building, will be erected parallel to the line of the drydock and water front, northeast of the main shops. Two lines of railroad tracks will extend past each end of the main metal working shops, and one track through their center. The main shops will be provided with overhead traveling cranes, the crane runways being extended through each end of the buildings over the railroad tracks. As far as possible, the present machinery will be utilized in the new shops. All of it will be electric driven, including both individual and group drive.

It is proposed to retain the drydock shops, for making repairs on the Atlantic side, until sufficient experience is had to determine the extent and character of repair facilities necessary.

For the handling of the lock gate leaves, as well as for other Canal requirements, and commercial and general wrecking purposes, one, or two, powerful floating cranes will be purchased. For handling vessels of the largest size at Cristobal and Balboa, two high power harbor tugs will be provided, and for the transportation of coal, fuel oil, and fresh water alongside of vessels, a sufficient number of barges and lighters will be placed in service. The steel barges, now in use by the Canal Commission, can be used to good advantage, after the necessary modifications have been
made, in the barge and lighter service. A tender for passengers and mail will be furnished at each terminus also, provided the business justifies it.

Some idea of the stupendous nature of the undertaking may be gained by a glance at the following table of statistics of the equipment in use during the construction period:

<table>
<thead>
<tr>
<th>CANAL SERVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam shovels:</td>
</tr>
<tr>
<td>105-ton, 5 cubic yard dippers ........................................ 15</td>
</tr>
<tr>
<td>95-ton, 4 and 5 cubic yard dippers .................................... 30</td>
</tr>
<tr>
<td>70-ton, 2½ and 3 cubic yard dippers .................................. 33</td>
</tr>
<tr>
<td>66-ton, 2½ cubic yard dippers ........................................... 10</td>
</tr>
<tr>
<td>45-ton, 1½ cubic yard dippers .......................................... 11</td>
</tr>
<tr>
<td>26-ton ................................................................. 1</td>
</tr>
<tr>
<td>Trenching shovel, ½ cubic yard dipper ................................ 1</td>
</tr>
<tr>
<td>Total ................................................................. 101</td>
</tr>
</tbody>
</table>

| Locomotives: |
| American— |
| 106 tons ............................................................. 100 |
| 105 tons ............................................................. 41 |
| 117 tons ............................................................. 20 |
| Total ................................................................. 161 |
| French ................................................................. 104 |
| Narrow gage, American, 16 tons ...................................... 33 |
| Electric ................................................................. 9 |
| Total ................................................................. 307 |

| Drills: |
| Mechanical churn, or well ............................................. 196 |
| Tripod ................................................................. 357 |
| Total ................................................................. 553 |

| Cars: |
| Flat, used with unloading plows .................................... 1,760 |
| Steel dumps, large .................................................... 596 |
| Steel dumps, small .................................................... 1,207 |
| Ballast dumps ......................................................... 24 |
| Steel flats ............................................................. 487 |
| Narrow gage ............................................................ 209 |
| Motor ................................................................. 6 |
| Pay Car ................................................................. 1 |
### PLAN AND OPERATION OF THE CANAL

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pay Certificate</td>
<td>1</td>
</tr>
<tr>
<td>Automatic, electric</td>
<td>45</td>
</tr>
<tr>
<td>Deauville</td>
<td>224</td>
</tr>
<tr>
<td>Special, shops</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>4,572</td>
</tr>
<tr>
<td>Spreaders</td>
<td>26</td>
</tr>
<tr>
<td>Track shifters</td>
<td>9</td>
</tr>
<tr>
<td>Unloaders</td>
<td>30</td>
</tr>
<tr>
<td>Pile drivers</td>
<td>14</td>
</tr>
<tr>
<td><strong>Dredges:</strong></td>
<td></td>
</tr>
<tr>
<td>French ladder</td>
<td>7</td>
</tr>
<tr>
<td>Dipper</td>
<td>3</td>
</tr>
<tr>
<td>Pipeline</td>
<td>7</td>
</tr>
<tr>
<td>Sea-going suction</td>
<td>2</td>
</tr>
<tr>
<td>Clam shell</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>20</td>
</tr>
<tr>
<td>Cranes</td>
<td>47</td>
</tr>
<tr>
<td>Rock breaker</td>
<td>1</td>
</tr>
<tr>
<td>Tugs</td>
<td>11</td>
</tr>
<tr>
<td>Tow boat</td>
<td>1</td>
</tr>
<tr>
<td>House boats</td>
<td>3</td>
</tr>
<tr>
<td>Clapets</td>
<td>12</td>
</tr>
<tr>
<td>Pile driver, floating</td>
<td>3</td>
</tr>
<tr>
<td>Crane boat</td>
<td>1</td>
</tr>
<tr>
<td>Barges, lighters and scows</td>
<td>72</td>
</tr>
<tr>
<td>Launches</td>
<td>29</td>
</tr>
<tr>
<td>Drill boats</td>
<td>2</td>
</tr>
<tr>
<td>Floating derricks</td>
<td>2</td>
</tr>
<tr>
<td><strong>PANAMA RAILROAD</strong></td>
<td></td>
</tr>
<tr>
<td>Locomotives:</td>
<td></td>
</tr>
<tr>
<td>Road (12 oil burners)</td>
<td>36</td>
</tr>
<tr>
<td>Switch</td>
<td>26</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>52</td>
</tr>
<tr>
<td>Cars:</td>
<td></td>
</tr>
<tr>
<td>Coaches</td>
<td>57</td>
</tr>
<tr>
<td>Freight</td>
<td>1,434</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,491</td>
</tr>
</tbody>
</table>
SUCCESS OF THE MILITARY MANAGEMENT

The writer confesses to having been one of the sceptics who viewed with misgiving the transfer of the Canal operation to military management, and he acknowledges with pleasure that in every important respect the results have been contrary to his predictions. The work could not have been in better hands. It has been carried on without any hitch or subsidence, and the progress made has excited the admiration and astonishment of engineers throughout the world.

An excellent organization has been established and a strong esprit de corps maintained. Health conditions were steadily improved and a gradual increase in the efficiency of labor effected. All classes of employees have been imbued with confidence and courage by the knowledge that their chiefs were moving along clearly cut lines, with well-defined purposes in view. For the first time
SUBMARINES TO BE USED IN DEFENDING THE PANAMA CANAL

The vessels here shown are to be used in defense of the Pacific side of the Canal. They appear as anchored in the new concrete docks at Colon, preparatory to their passage through the Canal, after having made the longest sea voyage on record for submarines.
since the enterprise was entered upon, the responsible heads of it were in complete accord with the controlling authorities at Washington.

The plan of organization of the Engineering Department divided all construction work into three topographical districts, each under the charge of an Assistant Engineer with full control and responsibility. These divisions are: The Atlantic Division, extending from deep water to Gatun Lake, and including the Gatun Dam and locks; the Central Division, extending from Gatun to Pedro Miguel, and including the Culebra Cut; the Pacific Division, extending from Pedro Miguel to deep water in the Pacific, and including the dams and locks at the former point and at Miraflores.
CHAPTER XII

MILITARY AND POLITICAL ASPECTS

For more than two hundred and fifty years the various nations of the world have been wrangling over the project of building a canal on the Isthmus of Panama. Diplomats have fought wordy battles and concocted wily schemes to secure a foothold on the Isthmus which would place their governments in an advantageous position either for building a canal or acquiring a strategic position in case one was built by another nation. Spain, England, France, Colombia and the United States have figured as the principals in these diplomatic negotiations. Although there have been other nations involved none have played a part sufficiently noteworthy for mention.

Of course Spain, as the first nation on the ground, was chiefly concerned with the canal project in its early days. Next England, whose traders and freebooters had obtained a foothold on the Spanish main, became a factor in Isthmian politics. The Englishmen had settled in Nicaragua and Honduras, Jamaica and others of the West Indian islands. Of these settlements, perhaps the most important, from a diplomatic point of view, was the English colony in that part of Nicaragua known as the Mosquito Coast. This colony was established in 1740, and some time later became a dependency of Jamaica. This foothold was gradually strengthened by treaty and otherwise, until England was enabled to organize a province there called British Honduras. Diplomatic discussion of this matter between England and Spain again and again resulted to the advantage of England, and her hold upon this territory grew stronger and stronger. In 1860 England was able to obtain an acknowledgment
from Nicaragua of the validity of her claim to British Honduras, and became a powerful factor in that part of the Isthmian country.

THE UNITED STATES TAKES A HAND

The United States, although naturally the logical builder of a canal on the Isthmus, was very slow to take advantage of the necessity and opportunity. It was not until about 1835 that any interest in such a project was manifested in this country. In that year the question of a canal was brought up in the Senate, with the result that an emissary was sent to the Isthmus to make an investigation of the matter. This move had no definite results until 1846, when a treaty was negotiated with New Granada by which the United States was given the sole right of transit across the Isthmus between the Atrato River and the Chiriqui Lagoon, either by road, railroad or canal. The limits of this treaty were sufficiently wide to provide a basis for the Panama Railroad concession, secured a few years later.

An attempt was made shortly afterward to negotiate the same privileges with Nicaragua, but complications were immediately encountered because of the fact that England was powerfully entrenched there. Various agents were sent to this country in an effort to conclude a satisfactory treaty. Finally, the negotiations resulted in the signing of a treaty with Nicaragua, guaranteeing that country sovereignty over the territory occupied by the canal which it was proposed to build. As this rather left England out in the cold, she immediately took steps to maintain her strategic position by threatening the seizure of Tiger Island in the Gulf of Fonseca, at the Pacific terminus of the proposed canal.

To block this move the United States, through its agent in Nicaragua, negotiated a treaty with that Republic by which Tiger Island was ceded to the United States, thus creating a difficult situation with England. A diplomatic
wrangle immediately ensued, which was settled in 1850 by the unfortunate Clayton-Bulwer Treaty, under which both governments agreed to forego the right to build or fortify an Isthmian canal, or to ally themselves with any Isthmian country for that purpose. Both countries offered protection to any other country which would undertake to build the canal, and guaranteed the freedom of a port at either end of the canal.

This treaty did not apply to British Honduras, and resulted greatly to the disadvantage of the United States.

This state of affairs maintained until after the Civil War in the United States, since that struggle occupied the attention of this country to so great an extent that the matter of building a canal was naturally held in abeyance. In 1866, however, the project again came up for discussion, and the people of the United States came to a clearer realization of the irritating features of the Clayton-Bulwer Treaty, and to desire a greater latitude of action upon the Isthmus of Panama. Various propositions were made looking to the abrogation of the treaty with England, among them being a project to buy Tiger Island. But these came to no definite end. President Grant was the first to advocate the clear-cut policy of an American canal under American control, and negotiations were entered into with Nicaragua in 1869 and 1870 with a view to building a canal across the Isthmus.

Soon afterward France entered the field of Isthmian diplomacy, Ferdinand de Lesseps making an attempt to secure an abrogation of our treaty with New Granada, in order that France might have the right to build a canal entirely under French control. The United States applied the Monroe Doctrine and adopted so firm an attitude on this subject, however that the attempt was abandoned.

GROWTH OF DEMAND FOR A CANAL

From this time on the American people turned their eyes more and more strongly to Panama and to the vital
necessity of this country for a canal under American ownership. The strong desire for this dates back to 1849 with the rush of the gold miners to California during the great gold strike in that State. Difficulty was experienced in crossing the continent because of a lack of transcontinental railroads and the length and tediousness of the journey by wagon train. A great many of the "forty-niners" chose to take ship to the Isthmus and brave the perils of the jungle and to pay the high rates exacted for crossing there. From this date our Far West grew rapidly in importance, and the necessity for some means of quick transportation, both for the purpose of defense and trade became more and more apparent, until, in 1898, the famous voyage of the Oregon around the Horn brought the crying necessity for a canal before the American people in such a way that public sentiment was aroused and became insistent that a canal should be built and owned by the United States as soon as possible.

THE VOYAGE OF THE "OREGON"

The American people will not soon forget the voyage of the Oregon. At the opening of the war with Spain, when the great Spanish fleet under Admiral Cervera was reported to be speeding across the Atlantic to make an attack upon the American coast, the Oregon, one of the finest ships in our none too large navy, was on the Pacific side. Need of her on the other side of the continent was felt so strongly that orders were telegraphed to her captain to make the long voyage around the Horn at the utmost possible speed. Never before had such a voyage at top speed been made by a battleship. Day by day the people hastened to open their newspapers to see where the Oregon was, and to wonder whether she would be able to make the long voyage without accident and arrive at the scene of action in time. The Oregon did make this memorable voyage without accident and in record-breaking time, and arrived in time to
take part in the battle of Santiago. Nevertheless, the lesson taught by the anxiety and suspense endured throughout many days was not soon to be forgotten, and the determination became stronger and stronger that such an emergency must never again arise and that some rapid means of communication between our coasts must be provided. Within two years a new treaty with England called the Hay-Pauncefote Treaty was negotiated, and ratified on December 16, 1901. By the provisions of this treaty the troublesome and annoying Clayton-Bulwer Treaty was abrogated. The United States was empowered to build and control a canal, both in times of peace and war. By this treaty we were forbidden to blockade the canal, but were not forbidden to fortify it, and thus all obstacles to the construction and ownership of a canal across the Isthmus of Panama were cleared away, and a way opened for the enterprise.

SELECTING A LOCATION

The next three years were occupied in selecting a location. Two routes were suggested, one on the location of the French attempt at Panama, and the other through Nicaragua. After careful study and investigation, however, it was decided to adopt the Panama route, as has been set forth at greater length in another portion of this volume.

The negotiations with Colombia, looking to the right to build a canal, have also been detailed at length, as have the dramatic revolution in Panama and the treaty with that country, which closed the diplomatic wrangling of centuries and left the United States free to build a canal under the conditions which we desired.

FORTIFICATIONS

Prominent among the international questions involved by the consideration of the canal has been the question of fortifications. By the Hay-Pauncefote Treaty we were not forbidden to place fortifications on the canal, and in
fact no mention of the matter was made. After the signing of the treaty, however, there was a great deal of discussion as to whether or not we had this right. The matter was not definitely settled until 1911, however, when an appropriation of $3,000,000 was made by the House of Representatives for this purpose. Work was begun immediately, and the huge forts which guard the waterway, armed with the latest and largest type of mortars and disappearing rifles, have settled this question for all time.

The questions raised on this subject involved not only our right to fortify the canal, but also the expediency. As on many other questions which have arisen concerning methods of policy connected with the canal, the people of the United States were divided into rival camps on this subject. The opponents of fortifications presented many arguments in support of their position. In the first place it was claimed that no fortification was necessary, inasmuch as the canal could be protected by our fleet. This argument was met by a consideration that in that case our fleet in time of war would be largely tied down to a defense of this important avenue of communication, and would lack the freedom of action which would be most favorable to its success. Further argument along this line was that this would be a far more expensive method of defending the canal than the proposed fortifications, since it would be necessary to provide a fleet of sufficient size to take care of the defense of the canal, in addition to the ships necessary for the defense of our extensive coast line. Many other arguments were brought up by those opposed to fortifications, but these were disposed of along the same logical lines.

The doctrine of non-militarism is the one chiefly expounded by those opposed to canal fortification. Up to the present time our theory of national defense was largely based on the belief that no enemy could successfully attack us because of the ocean lying between. In these days of high speed ships, however, the long stretch of South America,
PANAMA, PAST AND PRESENT.

Scene showing the repaving of one of Panama's old muddy streets with vitrified brick. Sewers and waterpipes have been laid throughout the city resulting in a great reduction of disease.
The fact that we have fortified the Canal does not in any way conflict with our treaty obligations to maintain a neutral commercial waterway, but we must insist on considering the Canal a part of our coast line, and as such falling under our rightful control as the great highway between our Atlantic and Pacific shores. The sentiment to this end has been growing ever since the Canal project became a concrete one. If a precedent were needed, we have it in the precautions taken by England to guard the approaches to India by means of fortifications at Gibraltar, Cyprus and at Malta, which guard the entrance to the Mediterranean. The Red Sea is protected by fortifications at Aden and on the Island of Perin, and to make matters doubly sure England owns a controlling interest in the Suez Canal. Other nations, furthermore, have pursued similar tactics. Germany has securely fortified the Kiel Canal, and there are other instances of a similar nature.

The control of the Panama Canal is, however, far more necessary to our national security than that of the Kiel Canal to Germany or the Suez Canal to Great Britain, since it is the key to the protection of our many thousands of miles of coast line and the seaports which dot it, and it is only right that we should adopt similar precautions to insure our safety by its adequate defense. One of the chief difficulties with the Clayton-Bulwer treaty was the clause which guaranteed to England a free passage through the Canal in case she was at war with this country, and it was largely on this account that pressure was brought to bear for a repeal of this treaty.

There are two branches of defense which must be considered, namely:—sea and land. The sea defenses will be provided for in the enormous fortifications with their powerful artillery, which are situated at the Atlantic end on both sides of Limon Bay. At the Pacific end the fortifications are placed on the islands which guard the entrance to the Canal. These fortifications serve a double purpose, as they will be the means of keeping a hostile fleet at a distance
too great for any bombardment of the locks and machinery of the Canal. They will also serve to protect the exit of our fleet in case it should be necessary to send it through the Canal in the face of a hostile fleet. The second branch of defense of the Canal must provide against an attack by a land force. This will be accomplished by the mobile land garrison, which will be employed to defend the Canal against a landing force from an enemy’s fleet, or from an army which would approach to the attack through one of the South American republics.

In the first instance, the proposed garrison of six or seven thousand men would probably be ample to repel any such attack, and the further consideration that it would be very difficult to land any force on the Isthmus in the face of a defending fleet makes this item of little consequence. In case, however, of the expedient of bringing a large army to attack the Isthmus by land, we are in a particularly favorable position to reinforce the garrison by either one of the two oceans, and we can probably put a sufficient force there to insure adequate defense before a hostile army would be able to reach and attack the Canal.

As now planned the land garrison will consist largely of infantry with full artillery, and a small body of cavalry. These men will maintain a permanent garrison, and thorough and detailed plans will be worked out for a complete defense of the Isthmus. With the completion of the Canal the entire Zone, with the exception of the stretch occupied by the Canal itself, together with a few military roads, will be allowed to relapse into the original jungle, and as growth is very rapid in the tropics it will be but a short time until this is again in the wild state and will thus form one of the best defenses against a land force. For this reason the Isthmus will not be open to settlement, but will be maintained strictly as a Government reservation; and no one will be allowed to land there without the express permission of the Government.

In addition to the defenses of the Canal itself, the
enormously strong naval base which we are constructing at Pearl Harbor in the Hawaiian Islands may be counted upon to assist materially in the defense of the Pacific end of the Canal.
CHAPTER XIII

THE RESULTS OF OPENING THE CANAL

Ever since the project of cutting an Isthmian canal has begun to be talked of in the United States, the question of what the results attained by it would be has been a matter for serious discussion.

As the enterprise neared completion this discussion became more general and of deeper interest to the people at large, especially to those interested in shipping and in transcontinental and foreign commerce. Congressional investigations have been made, and special reports prepared on the subject, until now we are in a position to predict along fairly definite lines what the net results of the opening of the canal will be.

The benefits which will accrue to this country fall into two major classes:—military and commercial. It has long been said that a Panama canal is a commercial convenience and a military necessity. But to the people at large the commercial aspects of the canal are pre-eminent, and they look to it for great results in the reduction of the risks and expenses of commerce.

FROM A MILITARY POINT OF VIEW

From a military point of view the canal will prove of the greatest value. The United States is in a most peculiar position as a world power, on account of the enormous extent of our coast line and the fact that it fronts upon both the Atlantic and the Pacific, upon both of which oceans it is necessary to maintain a powerful naval force. Without the Panama Canal the Atlantic and Pacific fleets are nearly
fourteen thousand miles apart, and the seriousness of this matter was best evinced to the American people by the spectacular voyage of the “Oregon” during the Spanish-American war. In other words, it is necessary to maintain two fleets, each one capable of defending the entire eastern or western coast line without assistance from the other side of the continent. This state of affairs is not only expensive, but to a certain extent dangerous, unless we are able to keep both fleets up to a standard of efficiency greater than that of any fleet which could be brought from any eastern or western nation to attack our ports.

By means of the Panama Canal, however, either fleet could be reinforced within a short space of time, and thus the mobility of both fleets will be greatly increased. Furthermore, the Panama Canal with its enormously strong fortifications, its dry-docks, coaling and supply stations, will form a naval base at the sole connecting link between the Atlantic and Pacific oceans. From the standpoint of a military expert this is a most important matter and it has been said that the canal will double the efficiency of our eastern and western fleets. The authorities at Washington were keenly aware of the advantage of such a naval base, and wisely omitted any clause in the Hay-Pauncefote Treaty which forbade us the privilege of fortifying the canal.

COMMERCIAL ASPECTS

So much for the military aspect of the canal. The results of opening the waterway to commerce are far reaching and complex. Since the opening of the first railway to the Pacific, in 1869, shippers have had the choice of rail and water routes for the transportation of their freight from coast to coast, and, in spite of artificial restraints upon the competition of the water routes with the transcontinental railroads, the rates by rail between the two seaboard have been affected by those charged by the carriers by water. The Panama Canal will shorten and
improve the intercoastal water route and will greatly increase the influence which the coastwise lines will be able to exert upon the railroad services and rates. The volume of traffic moving coastwise will be greatly enlarged by the canal. Some goods now handled all-rail will move by water or by rail and water lines, and there will necessarily follow a modification of rail rates and a readjustment of the relation of the charges of rail and water lines.

What the actual freight rates between the Atlantic and Pacific seaboards will be, by rail and water lines, after the opening of the Panama Canal, and what shares of the total traffic will move coastwise and by rail, can not be predicted in advance; but inasmuch as the division of intercoastal traffic between the water and rail carriers and the rates charged by the competing ocean and rail routes may be affected by the tolls charged for the use of the Panama Canal, it is desirable that before fixing the tolls as complete information as it is practicable to secure should be obtained concerning the existing traffic and rates of both the water and the rail lines connecting our two seaboards. Accordingly, it is proposed to explain the nature of the traffic now carried by water routes between the two seaboards.

It is well known that only partial information regarding the traffic by rail between the eastern and western sections of the United States is obtainable, but enough facts are known as to the total transcontinental rail tonnage and as to the seaboard and inland origin and destination of that tonnage to give some indication of the probable effects of the Panama Canal upon the traffic and upon the rate policies of the eastern, southern, and transcontinental railroads. It will be possible to present in sufficient detail the traffic and rates of the coast-to-coast carriers by water and to compare the present intercoastal rates by water and rail lines. It will be understood that the conclusions as to the effects which the Panama Canal will have upon the transcontinental traffic and rates of the railroads must be only tentative.
Shipment between the two seaboards of the United States may move by three water routes that compete with the rail lines connecting the two coasts, (1) the all-water route around South America via Cape Horn for sailing vessels and through the Straits of Magellan for steamers; (2) the route by way of Panama with the transfer of traffic by rail across the Isthmus; and (3) the route via the Isthmus of Tehuantepec, across which, from Puerto Mexico on the Gulf to Salina Cruz on the Pacific, freight is handled by a railroad owned by the Mexican Government.

Traffic carried by rail lines between the Atlantic and Pacific seaboards may move coastwise for a short distance on each seaboard—as from New York to Norfolk or from Portland, Ore., to San Francisco at the beginning or end of the railroad haul across the continent. The only railroad controlling a through route between the Atlantic and Pacific seaboards is the Southern Pacific, which operates the Morgan Line of steamers between New York and New Orleans and Galveston. The steamers of the Morgan Line extend the Southern Pacific route from the Gulf termini of the railroad to New York, and thus enable the Southern Pacific to compete both with the other transcontinental railroads and with the intercoastal water routes around South America and across the Isthmus of Panama and Tehuantepec. This combined rail and water line of the Southern Pacific is called the “Sunset-Gulf Route.”

1. The oldest route between the two seaboards of the United States is the one taken by sailing vessels around Cape Horn. Prior to 1849, however, only an occasional vessel, which was in most instances a whaler, undertook the voyage between the Atlantic and Pacific, but with the discovery of gold at the close of 1848, and for a few years thereafter, there was a very large use of this route. In 1849, 775 vessels cleared from the Atlantic seacoast for San Francisco and all but 12 of them were sailing vessels.
CUCARACHA SLIDE ATTACKED BY A FLEET OF DREDGES

This great slide has been the source of much trouble to the engineers. At one time it entirely blocked the Canal at the narrow point shown in this photograph, but the seven dredges of the ladder, suction and dipper type, made short work of cutting the 150-foot channel shown here, and then proceeded with the work of entirely clearing the cut. The view looks north from the slide past Gold and Contractor's Hills.
THE RESULTS OF OPENING THE CANAL

The opening of the Panama Railroad early in 1855 caused most of the traffic between the seaboards to abandon the long route around South America, but a considerable number of sailing vessels were annually dispatched between the two seaboards by way of Cape Horn, and a small amount of steam tonnage made use of the Magellan route.

The superiority of steamers over sailing vessels for handling most classes of freight, even for such a long route as that between the two seaboards of the United States around South America, became evident during the 1890's and caused the company which was then operating the principal line of sailing vessels between our two seaboards by way of Cape Horn to sell its sailing vessels and to inaugurate, in 1899, the American-Hawaiian line of steamers run by way of the Straits of Magellan. Early in 1907 the American-Hawaiian line shifted to the route via the Isthmus of Tehuantepec, and since that date practically all of the shipping moving between our two seaboards around South America has consisted of chartered sailing vessels and steamers that handle such bulky cargoes as can be economically shipped by that circuitous route.

2. The Panama route between our two seaboards was opened for traffic at the close of 1848, at the time of the rush to the California gold fields. With the completion of the railroad from Colon to Panama, early in 1855, most of the traffic between our two seaboards moved by way of Panama; and this continued to be the principal highway for transcontinental traffic until 1869, when the connection of the Missouri River with the Pacific coast by the Union and Central Pacific Railroads established the first rail line across the United States. The traffic by way of Panama rapidly fell off after 1869; and, though varying from year to year, remained comparatively small until 1911, when there was a sudden increase in the volume of traffic by water between our two seaboards.

Several causes account for the relative unimportance of the Panama route since 1869. The transcontinental
railroads, until recently, have maintained a relentless competitive warfare against the Panama route. The through rail rates between the Atlantic and Pacific seaboards are lower than the rates for shorter hauls to and from the intermediate points in the Rocky Mountain territory; and, until the Government regulation of railroads became effective, the railroad companies quoted shippers such rates as were necessary to keep traffic from taking the Panama route. Moreover, the transcontinental railroads were able to restrict the use of the Panama route through their close relations with the Pacific Mail Steamship Company, which has, for most of the time, been the only regular line between the west-coast ports of the United States and Panama. For a period of 20 years, ending in 1893, the railroads, through the Transcontinental Association, paid the Pacific Mail Steamship Company a fixed monthly sum, or rental, for the freight space available in its steamers, and thus completely controlled the Pacific Mail as a competitor. From 1900 to the present, the Southern Pacific Company has owned a majority of the stock of the Pacific Mail Steamship Company. The history of the relations of the Pacific Mail to the transcontinental railroads and to the Panama Railroad need not be presented in this account of the traffic and rates by the various routes connecting the two seaboards of the United States.* It is sufficient to state that

* For the history of the relations of the Panama Railroad to the Pacific Mail Steamship Company and for an account of the connection of the Pacific Mail with the transcontinental railroads, the following references may profitably be consulted:


(2) Statement by Edward A. Drake, vice-president Panama Railroad, to the Committee on Interocenic Canals, United States Senate, Feb. 11, 1910.

(3) Report of Joseph L. Bristow, special Panama Railroad commissioner, to the Secretary of War, June 24, 1905, upon the Policy to be Pursued in Management of the Panama Railroad Company (Government Printing Office, Washington), also report of Jan. 20, 1908, on the Advisability of the Establishment of a Pacific Steamship Line by the Isthmian Canal Commission (3. Doc. No. 409, 62d Cong., 2d sess.).

(4) Statement by R. P. Schwerin, vice-president and general manager Pacific Mail Steamship Company, to the Committee on Interocenic Canals, United States Senate, on Senate bill 428, Mar. 10, 1910. Also statement by Mr. Schwerin before same committee, on House bill 21600 Mar. 1, 2, and 3, 1912.

the transcontinental railroads by active competition and by artificial restraint have, until recently, kept the traffic via the Panama route comparatively small.

The development of traffic via Panama has been hampered, not only by the competition and restraint of the transcontinental railroads, but also by two other causes. While the French company was engaged in construction work on the Isthmus from 1882 to 1889, the use of the Panama Railroad by commercial freight was restricted by employment of the railroad for the transportation of materials and supplies used in construction work. Likewise, since 1904, the construction of the canal has limited the volume of commercial freight that could be handled across the Isthmus. The other cause that has checked the growth of traffic via Panama has been the competition of the Tehuantepec route, which, since the beginning of 1907, has afforded a shorter and better transportation route than the one by way of Panama for the traffic between the two seaboard of the United States. The volume of traffic handled via Panama between our two seaboard during recent years has been small and has tended to decline on account of the absorption of the Panama Railroad in Canal work.

3. The Tehuantepec route was opened for traffic early in 1907, when the American-Hawaiian Steamship Company took its steamers off the route via the Straits of Magellan and established regular line services on the Atlantic between New York and Puerto Mexico and on the Pacific between Salina Cruz and Hawaii and the west-coast ports of the United States. In 1906 it made an agreement with the Tehuantepec National Railway, which is owned by the Mexican Government, stipulating that the railway company should receive one-third of the through rate. This agreement also included a guaranty on the part of the Tehuantepec National Railway that the net earnings of the steamship company, per ship ton, should not be less than the earnings had been in 1904, when the steamship company was operating by way of the Straits of Magellan,
This guaranty, however, did not require the Tehuantepec National Railway to reduce its share of the gross receipts of the steamship company to less than 25 per cent. The American-Hawaiian line has been very successful. The fleet of the American-Hawaiian Steamship Company increased from 3 steamers in 1899 to 9 steamers in 1904, and to 17 in 1911. Five new steamers were ordered in 1911. The rapid growth in the traffic of the company has been made possible by the sugar tonnage from Hawaii to the eastern ports of the United States. The freight shipments westbound between our two seaboards are larger than those eastbound, but the exports of Hawaiian sugar have enabled the American-Hawaiian Steamship Company to run its steamers loaded in both directions. Indeed, the exports of sugar from Hawaii have been much larger than the American-Hawaiian Company could handle.

The through route between the two seaboards via the Southern Pacific Railroad from the Pacific coast to Galveston and New Orleans and from those cities to New York by the Southern Pacific Company's steamers (the Morgan Line) was established in 1883. The Sunset-Gulf route immediately began an active warfare against its competitors by rail and by water lines, and secured a large share of the traffic from coast to coast. The transcontinental railroads, other than the Southern Pacific, ran from the Mississippi and Missouri Rivers to the Pacific coast and were primarily interested in the development of traffic between the Middle West and the Pacific coast. The rates by the Sunset-Gulf route from New York to San Francisco were made the same as the rates by the transcontinental lines from St. Louis and Missouri River crossings to the Pacific. Gradually the rates by the through all-rail lines from the Atlantic to the Pacific were made the same as the rates from Chicago, St. Louis, and Missouri River crossings to the Pacific seacoast. This system of blanket rates was worked out by 1896, and has since prevailed on west bound traffic. The establishment of the same rates
by the Sunset-Gulf route and by the all-rail lines between the two seaboard lines allied the Sunset-Gulf route with the all-rail lines as common competitors against the water routes around South America and via the Isthmus of Panama and Tehuantepec. The control of the Pacific Mail Steamship Company by the transcontinental railroads since 1874, and the ownership of the Pacific Mail by the Southern Pacific from 1890 to the present, enabled the transcontinental railroads, as has been explained, to keep the traffic by the water routes within small proportions, until a few years ago, when the American-Hawaiian Steamship Company, and later the California-Atlantic, developed a relatively large tonnage coastwise via the Tehuantepec and Panama routes. This development of the coastwise business during the last few years has not been seriously opposed by the railroads, doubtless because of the rapid development of the rail tonnage consequent upon the industrial progress of the Intermountain and Pacific Coast States.

The volume of traffic handled between the Atlantic and Pacific ports of the United States by the several water routes has been constantly on the increase for a number of years, showing the rapidly growing need for the canal. The total tons of freight, not including Hawaiian sugar, rose from less than 500,000 tons in 1906 to over 800,000 tons in 1911. If the tonnage of Hawaiian sugar be included, the increase during the six years in total traffic was from 560,000 to 1,104,000 cargo tons. The increase during the four years ending in 1911 was steady and rapid. The decline during 1907 and 1908 is to be accounted for mainly by the San Francisco earthquake and fire.

An important feature is the separation of total traffic into that handled by regular steamship lines and that carried by individual vessels owned or chartered by the shippers. The traffic handled by the regular lines more than trebled during the six-year period, while that carried by individual vessels decreased more than 50 per cent. In 1911, 82.3 per cent of the entire traffic, other than
Hawaiian sugar, was carried by the regular lines, whereas in 1906 only 42.1 per cent was shipped by the established steamship lines.

The volume and variety of the traffic between the two seaboards of the United States have so expanded as to render the services of established steamship lines having regular and frequent sailings more economical than the services of individual vessels carrying full cargoes of single commodities. The traffic manager of the American-Hawaiian line stated to the Interstate Commerce Commission, on January 16, 1907, that—

We carry practically everything. In the course of a year I think we have at least 90 per cent of the articles that may be named in the trans-continental tariffs and a great many articles not on any tariff that are continually offered and carried.

The traffic carried by way of the Panama route also includes a large variety of commodities. The west-bound freight tariff of the Panama Railroad Steamship Line requires 25 pages to enumerate the several articles upon which individual rates are quoted. The east-bound tariff of the California-Atlantic Steamship Company is a type-written document of 20 pages.

The freight carried between our two seaboards by way of Panama and Tehuantepec originates and terminates not only at the Atlantic and Pacific ports, but also at interior points. Manifests of the shipments by the American-Hawaiian line enumerate commodities shipped from eastern New York, eastern Pennsylvania, Massachusetts, New Jersey, Vermont, Connecticut, Rhode Island, Maine; also commodities from Syracuse and Buffalo, N. Y., from numerous cities in Ohio, from certain cities in Michigan, and from Chicago, Milwaukee, and St. Louis. These same manifests show that this freight is destined not only to Pacific coast ports, but to inland points, such as Sacramento, Stockton, The Dalles, Ore., Spokane and Everett, Wash., and Reno, Nev.
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Most of the bulk cargoes handled in vessels owned or chartered by shippers now move by the disadvantageous routes around Cape Horn or through the Straits of Magellan. The opening of the Panama Canal will make it possible for the individual ship to engage in intercoastal traffic under much better conditions. It is not probable, however, that the percentage of the total traffic handled by individual vessels will increase in the future. It is more probable that the percentage of the entire business handled by lines will increase. Most of the traffic from our Pacific to Atlantic ports carried in individual vessels owned or chartered by the shipper will necessarily consist of cargoes of grain, lumber, and sugar. The sugar traffic is already large and may be expected to become heavier. The shipments of grain from the west coast, especially from Puget Sound ports, to Europe through the canal will be large, but it is not probable that the grain from the northwestern part of the United States will find very much market at the Atlantic seaboard. That section of the United States will in all probability be supplied from the grain fields of the Middle West. Barley from the Pacific Coast States will be required in the Mississippi Valley and Atlantic coast sections of the United States, and may be shipped in vessel cargoes as charter traffic. However, such commodities as wheat, barley, wool, canned salmon, and others of a like character that might advantageously be shipped as full cargoes in chartered vessels will probably be carried eastbound mainly by line vessels, because of the fact that the tonnage of traffic westbound is normally heavier than the tonnage eastbound. Line vessels will seek these bulk commodities as supplemental cargoes eastbound and at low rates. As was stated above, the American-Hawaiian line has developed a profitable business by securing a heavy eastbound tonnage of Hawaiian sugar. In 1911 the Hawaiian line transported 295,800 tons westbound, but only 162,500 tons, other than sugar, eastbound.

The lumber shipments from the Pacific coast through
the canal will comprise a large tonnage, but the destination of most of the traffic will be Europe and not the eastern part of the United States, which will continue to be supplied mainly from the forests in the Southern States. The southern pine and hardwood forests constitute the largest lumber-producing district in the United States at the present time. Shipments are made economically and expeditiously both by all-rail routes to northern markets and also by rail to southern seaports and thence by coastwise vessels.

Upon the opening of the Panama Canal it is probable that manufacturers and other large shippers will employ their own or chartered vessels for shipments of some heavy commodities to Pacific markets. Undoubtedly there will be a good deal of coal shipped westbound in chartered vessels. Fertilizers, heavy iron and steel, and some other commodities may be sent as bulk cargoes in individual ships from time to time. It is probable, however, that most commodities, other than coal and fertilizers, will be shipped by line steamers.

The fact that most of the traffic through the canal between the two seaboard of the United States will be handled by regular steamship lines and that only a minor, and probably a decreasing, percentage of the total will be transported in individual vessels owned or chartered by shippers should be given careful attention in considering, (1) what the policy of the United States should be concerning the prohibition of the use of the canal by vessels controlled by railroads, and (2) concerning the remission or omission of tolls upon vessels engaged in the coastwise business.

1. The policy of denying the use of the canal to vessels owned or controlled by, or affiliated with, railroad companies is advocated by those who favor the policy mainly for two reasons, (a) that the competition between the railroad-controlled and the independent steamship lines will be disastrous to the independent lines, and (b) that the Government regulation of the rates and services of
THE WEST BREAKWATER, LOOKING SEAWARD FROM TORO POINT.

The illustration shows a dredge at work placing rock on the face of the breakwater which is designed to form a safe harbor for ships entering the Canal from the Atlantic. Similar breakwaters protect the Pacific entrance.
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ocean carriers is impracticable and undesirable. If coast-
wise traffic through the canal were to be handled mainly
by individual vessels owned or chartered by shippers,
Government regulation would, indeed, be impracticable;
but the service of steamship lines operating over established
routes is not essentially different from the transportation
service of the railroads. Moreover, when several steam-
ship lines operate over the same route or over competing
routes they have fixed schedules of rates established by
agreement and their rate policy differs in no marked degree
from that of competing railroads.

The rates charged by steamship lines differ fundamentally
from charter rates, which are highly competitive and fluctu-
ate with the supply of and demand for chartered tonnage.
Charter rates fluctuate according to business conditions
and could not be and ought not to be subject to Govern-
ment regulation. The rates of steamship lines, however,
are not only made in conferences of the competing lines,
but also in many cases are fixed with reference to the rates
charged by the railroads with which the steamship lines
must compete for traffic. It is thus at least doubtful
whether it is good public policy not to regulate the rates
and services of coastwise steamship lines. Whether such
regulation is wise or unwise, it is at least not impracticable.

2. The question of exempting coastwise shipping from
the payment of Panama Canal tolls should be decided
with reference to the parties that would be benefited by
that policy. If the tolls charged coastwise ships using
the canal are added to the rate of freight paid by shippers,
the remission of tolls will benefit the shippers and possibly,
to some extent, the general public. On the other hand,
if the freight rates are not any higher because of the tolls,
the exemption of ships from the payment of tolls will not
affect the freight rates, and the exemption of the payment
of tolls will benefit the steamship company and not the
shippers. Charter rates, as has just been stated, are highly
competitive and the rates which a shipper must pay to
secure the use of a vessel for a trip through the canal will undoubtedly be increased by the amount of tolls paid. Shippers using vessels which they own or charter will receive the benefit of the exemption of canal tolls. On the other hand, the rates charged by steamship lines, being regulated by agreements among competing companies and being fixed with reference to what the traffic will bear, will presumably be as high as traffic conditions warrant regardless of canal tolls. If the tolls are charged, the operating expenses of the steamship companies will be increased by the amount of the tolls and their net profits will be lessened by the same amount. In other words, free tolls will be a gratuity or a subsidy to the coastwise steamship lines. There are reasons for believing that the rates of the coastwise steamship lines, which will handle from four-fifths to nine-tenths of the water traffic between the two seabords of the United States, will not be affected by the policy of the United States Government as regards free tolls.

Estimates of the comparative costs of shipment by the methods outlined above as against those via the Panama Canal all point to a saving of at least one-third in favor of the canal. The railroads charge about one-third of the through rate upon all freight carried between the coasts, and this on an average amounts to between $3.00 and $3.50 per cargo ton. Against this there will be merely the charge of $1.20 per net vessel ton exacted for the use of the canal. Inasmuch as a vessel ton is equivalent to 100 cubic feet of space, while a cargo ton is only equivalent to 40 cubic feet of space, these terms must not be confused. As a rule, freight vessels can transport more than two tons of cargo for each net ton of rating, an average of about two tons of freight capacity for each vessel ton. On this basis the tolls as fixed for the canal at present will only amount to about sixty cents per cargo ton, and the saving should be from $2.40 to $2.90 on each ton of cargo as against the railway transfer method.
THE RESULTS OF OPENING THE CANAL

There are many commodities which will be shipped via the canal which would not bear the double handling made necessary by the old method, either by reason of their fragile nature or the expense of double handling. Among the latter are lumber, coal, ore and such materials which are handled in bulk. This latter consideration will be of the utmost importance in connection with the great ore and nitrate deposits of the western coast of South America.

REDUCTIONS IN SHIPPING RATES

The matter of ascertaining the amount of reduction in costs made possible by the use of the canal is not difficult to determine. When, however, we attempt to investigate the matter of a reduction of charges a more difficult situation confronts us. While the freight rates charged by transcontinental railroads have been a great factor in creating a powerful demand for a canal, in the hope that water competition would result in reducing present rates, it is extremely doubtful if these reductions will bear a true proportion to reductions in costs, although the idea is prevalent throughout the country that such will be the case.

Our industrial history has shown very clearly that it is impossible to compel keen competition. Our railroad companies have pools, conferences, mergers, road understandings and agreements to such an extent that competitive rates do not exist, and the Interstate Commerce Commission is the only means open to the shipper of compelling a reasonable relationship between costs of transportation and rates. The rule of thumb by which railroad rates are fixed is the phrase, "all that the traffic will bear," and it seems likely that this method will also be followed in fixing the steamship rates through the canal, and the rates maintained by the same methods as have been followed in the case of the railroads. All of the great European transport lines are bonded together in rate agreements, and it is probable that the coastwise steamship lines using the Canal will be
operated under similar conditions, and the rates between the Atlantic and Pacific coasts will be the same by all rival lines. Of course there will be outside competition by means of privately owned or chartered vessels, but inasmuch as few shippers are able to forward in cargo lots this competition will amount to but a small percentage of the total volume of trade, practically all of which will be handled by the regular transport companies. These rates may be modified, of course, by extending the power of the Interstate Commerce Commission, or some similar body to their regulation, but it is probable that the same conditions which obtain in connection with the transcontinental railroads will reappear in connection with the Canal.

RAILROAD COMPETITION

From this arises the question of competition between the transcontinental railroads and the intercoastal steamship lines. It has been thought that the railroads would be compelled to reduce their rates to a competitive basis with the freight rates charged via the Canal, and it was with the idea of compelling such competition that railway-owned ships were forbidden the use of the waterway. Two sets of conditions are to be apprehended: the first, that rate conferences between the steamship and railroad companies will operate to maintain a non-competitive rate schedule between them; or, in other words, that both will continue to charge as much as the traffic will bear. The second condition is that only about ten per cent of the railroad traffic is billed through from coast to coast, and if the roads should reduce the rate on this class of traffic they would be compelled to adjust the rates to all intermediate points on a similar basis and thus cut heavily into their revenues. On this account it is altogether likely that the railroads will prefer to sacrifice the ten per cent of volume rather than revise all the existing rates on such a basis. Summing up the situation, we must not anticipate a heavy reduction in costs of transportation
between the coasts either by ship or railroad. Certain reductions, however, are bound to come, for the reasons that competition cannot be entirely eliminated, and the insistent demands of the public for rates which bear a reasonable relation to the costs of service must be taken into consideration in fixing rates; and there are certain commodities upon which the reduction is sure to be material, and a large number on which some reduction will certainly be made in order to fill the ships which will naturally enter into this business.

The most direct way of estimating what the people of the United States and of the world at large are to gain by the opening of the Panama Canal is to estimate the tonnage which will pass through the canal, and to divide this tonnage among the several classes of trade. It has been estimated that the traffic between the coasts of the United States will amount to only about one-tenth of the ships which pass through the canal, our trade with foreign ports will amount to about one-third, and that one-half of the traffic will be ships which do not touch the ports of the United States at any point, but simply use the canal as a short cut between the Atlantic and the Pacific.

To understand the relation of the now existing trade routes, and those which will come into being with the Panama Canal, a study of a route map is necessary which shows comparative distances on all of the principal trade routes.  

(See page 226.)

RESULTS FAR REACHING

It is difficult to foresee all of the results which will be obtained by the operation of the Canal, for the reason that they are so numerous and so far-reaching. It is probable that in course of time trade, political and banking conditions will be revolutionized to a degree unforeseen. The first effect will naturally be the tightening of the commercial ties between the eastern and western sections of the United
TRADE ROUTES AND DISTANCES BY EXISTING LINES AND BY THE PANAMA CANAL.
(See table on opposite page.)
THE RESULTS OF OPENING THE CANAL

States, due to the greatly increased facilities for transportation between them. With the increase in commercial relations will naturally come a greater community of interests, not only commercial, but political and social, and a closer welding of East and West.

DISTANCES IN NAUTICAL MILES

SAVED FROM NEW YORK VIA THE PANAMA CANAL ON TRADE ROUTES

<table>
<thead>
<tr>
<th>Location</th>
<th>Magellan</th>
<th>Panama</th>
<th>Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Francisco:</td>
<td>13,135</td>
<td>5,262</td>
<td>7,873</td>
</tr>
<tr>
<td>Guayaquil:</td>
<td>10,215</td>
<td>2,810</td>
<td>7,405</td>
</tr>
<tr>
<td>Callao:</td>
<td>9,613</td>
<td>3,363</td>
<td>6,250</td>
</tr>
<tr>
<td>Iquique:</td>
<td>9,143</td>
<td>4,004</td>
<td>5,139</td>
</tr>
<tr>
<td>Valparaiso:</td>
<td>8,880</td>
<td>4,683</td>
<td>3,747</td>
</tr>
<tr>
<td>Honolulu:</td>
<td>18,312</td>
<td>6,700</td>
<td>6,612</td>
</tr>
</tbody>
</table>
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Manila:
Suez......................................................... 11,589
*Panama.................................................. 11,548

Saved..................................................... 41

Yokohama:
Suez......................................................... 12,079
*Panama.................................................. 9,798

Saved..................................................... 2,281

Hongkong:
Suez......................................................... 11,628
*Panama.................................................. 11,383

Saved..................................................... 245

Melbourne:
Magellan.................................................... 12,852
Panama..................................................... 10,030

Saved..................................................... 2,822

THE CANAL AND THE COMMERCE OF AMERICA

The establishment of a waterway between the two great oceans of the globe will more widely affect the commerce of the world than any single work or event in its history. President Hayes, in 1879, declared that “an interoceanic canal across the American Isthmus will essentially change the geographic relations between the Atlantic and Pacific coasts of the United States and between the United States and the rest of the world.” The Panama route will effect much greater economies of time and distance than those that are at present secured by the use of the Suez Canal.

Colquhoun, in his "Key to the Pacific," says: "It will bind together the remote sections of that immense country, assimilate its diverse interests, go far towards solving many

* Via San Francisco and the Great Circle.
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GATUN LOCKS.

I. Steel emergency gate for protection of locks in event of accident.  J. First lock gate from Gatun Lake, coming from Pacific side.  K. Gatun Lake and Canal channel.  Lake now 45 feet above sea level.  Will be raised to 87 feet during coming rainy season.  L. Guide wall where vessels are taken in tow by the motors.
difficult problems, and make the United States still more united. . . . No greater impulse to commerce can be given than this complement to the Suez Canal. It will benefit America in an infinitely greater degree than Europe. . . . It will give an immense impetus to United States manufactures, especially cotton and iron, and will greatly stimulate the shipbuilding industry and the naval power of the United States."

Whilst the Panama Canal must prove an universal boon it will doubtless work to the detriment of some countries and certain industries, at least until after adjustment of the new trade relations. America will always be the greatest beneficiary of the advantages accruing from the use of the waterway and we will briefly consider a few of the changes in conditions that have been brought about by the completion of the enterprise to which so large an amount of American energy, intellect and capital has been devoted.

EFFECT OF THE CANAL ON THE COMMERCE OF THE SOUTH

No region in the United States can feel the immediate benefit of the new route to the same extent as the Southern States and the vast Valley of the Mississippi. The latter territory, the richest in all the world, one and a quarter million square miles in extent, intersected by five thousand miles of navigable waterway, with prolific soil and energetic people, finds new markets and a new outlet for its varied products no longer dependent upon expensive railway transportation. Chicago is nearly the same distance from New Orleans as from New York, but St. Paul, Omaha, Dubuque, Evansville and Denver are nearer to the former point than to the latter. It is quite probable that the present generation will see ocean steamships coming down from Duluth, through the Great Lakes, an inland canal, and the Mississippi River, to the Gulf of Mexico, and passing on to Pacific and Asian ports.

The new gateway to the Pacific will give a tremendous
impetus to the industries of the South. Its raw cotton, which for a decade has been making small gains, under difficult competition with the British East Indies and China, in the Japanese market, is relieved of an onerous handicap. The product of its mills, a coarse fabric, such as is especially adapted to the requirements of South American and Oriental consumers, must enjoy an enlarged demand under stimulating conditions. Heretofore almost all the cotton goods exported from this country to Asia has gone out through New York eastward by way of the Suez Canal.

Alabama coal will find a constant and extensive demand at Panama, which will become the greatest coaling port in the world. Birmingham, where iron can be produced more cheaply than at any other place on the earth, will find new markets in South America and Asian countries for its output. The steel, machinery, and various hardware of Tennessee and other Southern States, which have been reaching Australia and China during the past few years under the most disadvantageous conditions of shipment, can be sent through the Canal to these and other destinations at a cost which may defy competition. The large lumber and wood manufacturing industries of the South will be obviously benefited to a great extent by the creation of a short route to the western coasts of Central and South America.

GREAT BENEFITS TO OUR PACIFIC STATES

The immense saving in the journey from our eastern ports to the Pacific Coast will revolutionize the trade of the latter region. Von Schierbrand says:* "It has been computed that on a single voyage of a 1,500-ton sailing vessel between Port Townsend, Seattle or San Francisco and Boston, New York or Philadelphia, the saving effected in wages, repairs, insurance, provisions, and freight charges, by reason of the Panama Canal will aggregate between

$8,000 and $9,500." Many raw products of our Pacific Coast, which can not bear the cost of long railroad hauls, are made available to eastern markets at prices profitable to the producer and the manufacturer. This applies particularly to building lumber and furnishes a partial solution to the problem with which the rapidly disappearing forests of our middle and eastern states are confronting us. The economies effected in the transportation of the cereal and fruit products of California and other western regions may easily be imagined. Millions of pounds of fish were sent annually in ice across the continent, aside from the enormous quantities that went to Europe in English sailing vessels round Cape Horn. All this passes through the Canal.

The Canal is the means of enabling the people of the Pacific Coast to buy more cheaply and to secure better prices for their products. By breaking the monopolistic power of the railroads it will lead to the agricultural development of the unoccupied sections of this territory, to a vast increase in its population and to the creation of worldwide markets for its products.

A BOON TO THE NORTHEASTERN TERRITORY

...The industries of the northeastern section of the United States, that is to say the territory lying to the east of Pittsburgh and to the north of the James River, consist mainly of the manufactures of iron and steel, machinery, tools, etc., and textiles, coal mining, and shipbuilding. The exports of manufactured cotton from this and other parts of the United States go principally to ports in Asia and Oceania, where their chief competitor is the product of the British mills. It is not necessary to expatiate upon the advantage which the short route will give to us in this trade. The countries of South America expend about $80,000,000 annually in the purchase of cotton goods. At present, however, little more than five per cent of this
large sum is paid for American cloth, but the facilities for shipping economically that will be created by the Canal must have, among other results, that of giving to the manufacturers of our Northeastern and Southern States a very large share of this desirable business.

It is hoped that by the use of a new type of steel river barge of large capacity and small draft the coal of Pennsylvania and the Southern mines may be shipped direct to Panama at a cost of one dollar per short ton. This would allow of its being sold at three dollars, a figure sufficiently low to preclude successful competition. The ability to supply cheap fuel would not only accrue to the benefit of our coal mining interests, but would, where other considerations balanced, decide shipmasters in favor of the Panama route, for the contract price of steam coal at Port Said is about six dollars and the current price about ten dollars per ton.

OUR ADVANTAGE OVER FOREIGN COMPETITORS

The principal exporting competitors of the United States in the markets for the manufactures of iron and steel are Great Britain, Germany and Belgium. European producers can reach the west coast of South America, and the oriental countries in general, more readily than can our manufacturers, but the Canal will entirely subvert the condition in the favor of the latter. Few of our industries are likely to receive such an expansive impulse from that event as those dependent upon iron and steel for their material and the section which will benefit most in that respect is the coal and ore region of the South.

One of the most certain consequences of the increased American trade due to the waterway between the Atlantic and Pacific oceans will be the great extension of the merchant marine and the expansion of the shipbuilding industry of the country. The Canal will have the effect of largely increasing the coasting trade of the United States
and all the vessels engaged in it must be built in American yards. Aside from this the increased foreign trade under conditions that will make the shipping business once more profitable, must lead to the construction of a large additional number of American vessels, and the considerable benefiting of American shipbuilders, who find great difficulty in competing with those of Europe on account of our higher wage scales.

A large shipbuilder responded to an inquiry by the Isthmian Canal Commission with the following statement: "In my judgment the opening of the Isthmian Canal and the development of its traffic would stimulate American shipbuilding to the extent of an increased demand for vessels to be used in trade affected by said canal. As a rule increased demand develops increased sources of supply and the cost of product is invariably reduced in proportion of increased business to fixed expenses of any manufacturing establishment, and therefore the canal would in this case tend to enable shipbuilders to construct ships more economically and more surely to compete with foreign builders."

The foregoing are only a few illustrative examples of the benefits to certain portions of the United States conferred by the Panama Canal. Anything approaching a comprehensive statement of the matter would fill a large volume.

THE EFFECT ON OUR FOREIGN COMMERCE

But to gain a full view of all that will be accomplished it is necessary to go farther afield. Up to within the last few years the American people have been so largely occupied with the development of the enormous natural resources of this country they have had little time or necessity for the development of foreign trade, and the commerce of the world at large is carried on by European nations. This state of affairs cannot exist indefinitely, however, and our foreign trade is now growing very rapidly. In spite of this present great total, however, the
The effect of the Panama Canal will be to multiply it enormously. For instance, our percentage of the great trade with the western coast of South America is extremely small. The shipments from southern Chile of nitrate, copper and iron ores, etc., amount to an enormous tonnage each year. Of this the United States gets less than one-fifth. Grain shipments from western South America are also heavy, and practically all of this goes to Europe. With the Canal open the United States will be so much nearer than Europe that a large portion of this trade should eventually be diverted to the eastern coast of the United States, where our great manufacturing plants are located. The same conditions apply to Australia and New Zealand, with which we will be on a par with Europe so far as distance is concerned by the use of the canal, and our Atlantic coast will be 4,000 miles nearer Australia by Panama than by Suez. New York will be 5,000 miles nearer New Zealand by Panama than around the Cape of Good Hope.

Our traffic with the Far East, China and Japan, will likewise be greatly benefited by the new route, although not to such a great extent, as both China and the Philippines will be equally distant from New York via both the Panama Canal and the Suez Canal. From the standpoint of a reduction of distance the Panama Canal will undoubtedly benefit us to a very great extent.

The other considerations of costs of fuel, supplies, facility for repairs, etc., have been taken care of by the establishment of the great supply stations at Panama.

The Effect on Our Shipping Interests

The question of American shipping has been a sore point for many years. In fact, the American flag has almost disappeared from the world's merchant marine. There have been various causes for this, chief among them the high cost of labor, which has put the cost of building ships in the United States up to a prohibitive figure and made
it far cheaper to buy ships abroad and operate them under a foreign flag than to build here. Recent legislation admitting foreign built ships to American registry, together with the admission of necessary parts free of duty, looks to the remedy of this matter, and we shall probably see an enormous increase in the American registry within the next few years. Ships, however, which are engaged purely in the coastwise trade must still be built in the United States to obtain the privilege of American registry.

WILL THE CANAL PAY

The question of whether or not the Canal would pay has been one which has agitated the American people for some time. The maximum rate which has been authorized by Congress for canal tolls is $1.25 per ton on freight, and $1.50 per passenger, although these rates may be reduced by the President in case they are higher than necessary to produce the amount required for operation and maintenance, which will amount to about $4,000,000 annually. If we take into account the interest upon the investment at the rates at which the Canal bonds have been placed, the tolls must produce another $10,000,000 per year, or a total of $14,000,000 annually for the Canal to be self-supporting. It is not likely from the outlook that the Canal will pay for some years to come.
GATUN LOCKS.

A. Completed sea level section of canal, seven miles long, from Atlantic Ocean to Gatun Locks, where by a series of three locks vessels are raised to Gatun Lake 85 feet above sea level. B. Small area of land to be dredged away as soon as Gatun Locks are completed. C. Electric towing motor, four of which will tow each vessel entirely through the locks. They run on cog rail along the lock walls. D. Lock gate under construction. E. Floor of first lock from Atlantic side. Note holes in floor for admitting the water. F. Lock for vessels coming from Pacific side. G. Base on which concrete posts will be erected for electric lights. A row of lights on all sides of the locks will make operation at night as safe as day. H. Incline from locks of different levels up and down which the towing motors run on cog rails.