CHAPTER XII

THE WOMEN OF PANAMA

THERE was loudly expressed sympathy for Mrs. Smith all along the block when the awestruck neighbors learned that she was going to Panama. She was such a shy little creature, you know, hardly reaching to her husband's shoulder, and married only ten months! The idea of whisking her off to a jungle where snakes crawled into your bed, and alligators lurking around your back door, and you had to eat canned food or cocoanuts!

"They tell me that the snakes in Panama are twenty feet long," interposed Mrs. White with proper dramatic force.

"And they do say that the poor men who are digging the Canal have to sleep in the mud," chimed in Mrs. Stevens's shrill falsetto.

"They may think themselves lucky at that," contributed Mrs. Black gloomily. "My husband
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says that mosquitoes eat people alive down there!"

"Are you talking about the Smiths?" put in a new arrival. "Isn't it terrible about their going to Africa?"

"You mean Panama, don't you?" corrected Mrs. White.

The other shrugged her shoulders. "Oh, it's all the same. Anyway I guess Panama is the worst of the two!"

One may hear dozens of such expressions. The American people are digging the greatest waterway in history at Panama, and yet to our average citizen Panama seems as vague and as far away as Timbuctoo. His impression of the Isthmus is that of a vast swamp of black mud or a thick jungle of poisonous foliage—with the civilization of the swamp or the jungle. He views the men departing for the Panama Canal as our grandfathers viewed the California gold-seekers leaving for the long trip across the western plains.

Against this background he is apt to be dazed by the statements that the women of Panama have secured grand opera and have organized a chain of flourishing literary clubs and maintain a social life almost as modern and complete as
that of his own city. The woman who accompanies her husband to the Canal may view the prospect ahead as a long stretch of frontier hardship and sacrifice, and she may leave her new gowns and bonnets at home. The next letter to "the States" however will contain an urgent request that the aforesaid gowns and bonnets be shipped without delay. She has found that the women of Panama follow the prevailing styles almost as closely and have almost as many opportunities of exhibiting them as the women at home.

True, within half a mile or less of their back doors is a jungle which has defied civilization for nearly four centuries. True, they must take quinine with their breakfast food to escape the fever mists and must wage a constant war with the little tropical ants to save their parlor furniture. Also they see monkeys and parrots and lizards much oftener than horses and mules, and must substitute cocoanuts for apples and palm trees for maples, and must accustom themselves to an average temperature of something over one hundred degrees. These are the facts of Nature. But the women of Panama have risen above them.

They have faced the jungle unflinchingly and
in its isolation have seen both their greatest hardship and their greatest opportunity. They have combated the wilderness with the social, literary, and musical activities which it would seem to deny them the most rigorously.

A modern woman’s club in the jungle may appear impossible. The women of Panama have shown that not only is one club possible but more than a dozen. Grand Opera may appear as far removed from the wilderness as Caruso is from the Hottentot but with other co-operation the women of Panama have secured it.

Mrs. Graham’s card party or Mrs. Jones’s musicale or Mrs. Smith’s reception are society items which may seem as incongruous in the Panama jungle as an alligator on Broadway, but the visitor to the Isthmus will assure you that they are almost as significant a part of life in the Canal Zone as the new records of the steam shovels in the Culebra Cut.

The beautiful Government hotel, “the Tivoli,” is large enough and modern enough to permit of the most elaborate receptions. Built on the elevation of Ancon overlooking the city of Panama and the Pacific, its site is one of the most ideal on the Isthmus and the architects in charge of both the exterior and interior plans have endeavored to pro-
duce a building worthy of the natural advantages. At a casual glance, the Tivoli might be a popular hostelry located at any typical Atlantic watering place. From the lobby particularly there is nothing to suggest either the Panama jungle or the Panama Canal. During my visit, there were private dinner parties every night and some of them of quite a formal character. Indeed the dining-room showed almost as many men in conventional evening clothes as one would find at any representative hotel of "the States." A majority of the officials of the Canal have endorsed the Panamanian custom of white duck instead of formal black for after-dinner functions but against the background of glistening silver and gleaming lights this innovation increases rather than decreases the social atmosphere.

For the more elaborate receptions at the Tivoli a special train is often scheduled from Panama to Culebra in the early morning, dropping the guests at the various points along the line. The only feature that brings home the proximity of the wilderness is the fact that many persons in order to reach the city of Panama for evening entertainments are obliged to make the trip in the baggage car of a freight train, finding seats on upturned barrels and boxes.
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Such a journey in evening dress is not the most alluring prospect—particularly after the veteran railroader enlightens you as to the character of the Panama freight train—but the reception committee does put forth an honest effort to give you sufficient enjoyment at the end to atone for your bruised pride and perhaps your bruised body. If riding to a ball in a box car is descending to the primitive, the ball itself ascends to the heights of fashionable society. Panama, that is American Panama, will surprise the visitor quite as thoroughly at the Tivoli ballroom as at the Culebra Cut.

It is true that the social activities of the Tivoli from the standpoint of dollars and cents are beyond most of the women of Panama. As a matter of fact a comparatively small per cent. can afford the financial outlay which they demand. Admitting that Panama society is democratic—the officers of the leading club ranging from Colonel Goethals to a department clerk—the majority of the families of the Canal must confine their amusement to less expensive channels.

To find the real social side of the Isthmus, therefore, we must leave the rotunda of the Tivoli and journey out to the straggling settlements
The Women of Panama

dotting the line of the Panama Railroad. And we must choose one of the afternoons when most of the women's clubs are in session.

Perhaps our route has taken us to Gorgona, and our visit has fallen on the day when the Woman's Club is deep in a discussion of the approaching Christmas festivities. The Y.M.C.A., the Sunday-school and the public school of the village have been invited to co-operate with the club in the preparation of a record-breaking programme. They have all accepted the suggestion and we find the women entering into the project with a heartiness and enthusiasm which laughs at the obstacles of frontier civilization. The club is determined that this Christmas in the jungle shall be a memorable one. Home may be two thousand miles away but the women can create home cheer and home comforts in spite of this fact. Listen to the programme they are planning.

Of course the children of the village must have a genuine Christmas entertainment such as they have always known at home, with a Santa Claus and sleigh-bells—even if the thermometer is registering more than a hundred degrees! And there must be candies and oranges and toys in Santa's pack if the Government steamer has to make a special trip to New York
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for this purpose. And there must be a real Christmas tree, to be sure! The best plan will be to hold an old-fashioned Christmas Eve celebration in the Y.M.C.A. building. Then there will be room enough and welcome enough for everybody.

Can you wonder that the men of the steam shovels and "dirt trains" are smashing world records down at Panama, with women like these to inspire them?

There is no Christmas in city or jungle that is complete without the charitable feature. At home we give our surplus money and clothes to the ragged newsboys. But, you say, there are no newsboys in Panama? Oh yes, there are, and just as ragged and just as needy as those of New York. In the city of Panama, there are two daily papers besides those of Colon, and if they are delivered by little, dark-skinned urchins who combine the blood of half a dozen nations in their veins and sleep under a palm tree instead of in a frozen ash-barrel, the same field for charity exists—broader perhaps because it has been so long neglected.

The Woman's Club of Gorgona has these details in mind when the report of its philanthropical committee is called for, and the chair-
The Women of Panama

man announces that the members are sewing hard on a variety of garments to be distributed to the newsboys on Christmas day.

Now we come to a phase of charity in Panama peculiarly unique. Some one has reminded the Woman's Club of the leper colony at Palo Seco. Barred from friends, home, family, the unfortunate inmates must watch the approach of the great holiday with bitter emotions. They are cast off from the world and its joys and pleasures. Who more in need of Christmas gifts and Christmas sympathy? So an item is made of the Palo Seco lepers in the list of holiday preparations and the Gorgona women turn to other angles of their discussion.

Before we leave we learn that their organization includes a literary department which is pursuing an excellent course of study in Spanish; a musical department which is planning a programme of classical selections in the near future; and an historical department which is outlining a series of papers by its members on the early romance of the Isthmus.

All of these features, mind you, in the heart of an unexplored jungle! This is how the women of Panama are spending the long days when their husbands are toiling under the copper
rays of the sun and bringing the great Canal nearer and nearer completion.

If we are disposed to tarry at Gorgona we might make the acquaintance of the Chorus Club or the Girls' Bowling Club or the Dramatic Club, which renders four or five really excellent programmes in the course of a year. But we recall that this is only one point in our itinerary and hasten onward.

We chance to reach Ancon on one of those two days when the Woman's Club is holding its Christmas bazaar and find ourselves in a prettily decorated Japanese tea-room, with a confectionery counter adjoining and still beyond a cleverly arranged apartment where are exhibited children's gifts of all descriptions. We are rubbing our eyes when we reach the street and remember that we are in Panama.

We might increase our visits to Gatun, Paraiso, Empire, Cristobal, La Cascadas, Pedro Miguel, Culebra, and other of the Canal settlements and in all of them find the women organized quite as effectively and enthusiastically as at the points we have mentioned, for the Panama branch of the American Federation of Women's Clubs is nothing if not thorough and it might almost be said that it has established itself wherever
the zigzagging line of the railroad is dotted by a handful of houses.

To the personal efforts of Miss Gertrude Weeks and Miss Helen Boswell, working under the auspices of the American Government, much of this success is due. It required not only a tremendous amount of preliminary labor by pioneers such as these for the establishment of a chain of women's clubs in a tropical jungle, but it has needed hard and constant effort to keep the chain up to a standard of real efficiency. What the Y. M. C. A. has done for the men of Panama the Federation of Women's Clubs has done for the women of Panama.

The success of the Canal-builders of the Isthmus has ever depended upon the success of the Civilization-builders. The French stumbled past this fact completely and devoted their energies entirely to the mechanical side of the undertaking, forgetting that beneath it there was a human side. Whether they could have dug the Canal under any conditions is a question, but it is certain that the task would have been impossible on their principle of viewing men like machinery. The United States saw their error and escaped it at the cost of being denounced for gingerbread trimmings and a useless waste of public money.
The cynic laughs at the women's clubs and the Y. M. C. A. buildings, forgetting that three fourths of the Isthmus is a jungle and that when the forty thousand men in its heart have completed the day's work they have still four or five or six hours they must pass—how? And with the women these hours are multiplied two and three times until they stretch out to a long day there in the wilderness with home thousands of miles away and the dangers of the jungle always at their elbows.

The women's clubs may be denounced as a "fad" but through them the Government has found one of its most powerful channels of reaching and inspiring the toiling men of the Canal. The cheery wife at the front door braces the weary man for his next day's work as all of the gold of the nation could not do—and in her turn she has been strengthened for her battle with hardship and solitude and discouragement, and thus enabled to renew the drooping spirits of the family circle, by two paramount factors.

One is her own optimistic, inspiring, unselfish American womanhood. The second is the organized club and social life which allows her to forget the wilderness at her back door.
CHAPTER XIII

LIEUTENANT ISAAC C. STRAIN—HERO

HERE is the story of the man who dared and won at Panama in the days before Colon had outgrown the mud-village period, when the Isthmus was called "Darien," and hostile Indians lurked behind the palm trees with drawn bows and little poisonous arrows. In all of the grim history of the Panama jungle there can be found no more thrilling example of man's bravery than the story of the American naval expedition that made the first survey from Caledonia Bay to Darien harbor under the leadership of Lieutenant Isaac C. Strain. And in all of the annals of the American navy, whether of peace or war, no more lion-hearted character stands forth than that of Lieutenant Strain. To the world—even to present-day Panama—Strain may be an "unknown celebrity," but in the roll of the world's heroes who have confronted their duty unflinchingly in the face of hardship, privation, death, no name is more vividly underscored.
The Conquest of the Isthmus

The history of the Strain expedition is as dramatic as a romance. With the touch of J. Fenimore Cooper it would take rank as one of the most absorbing tales of wilderness-adventure ever written. But the world would regard it as fiction and digest it as such.

It was in the winter of 1854 that the Cyane dropped anchor in Caledonia Bay and Lieutenant Strain and his party of twenty-seven men saw the frowning shores and vast green stretches of foliage behind which—how many miles they did not know—lay the harbor of Darien.

Although the discovery of the Pacific had taken place nearly four hundred years previous, an accurate survey had never been made of the winding land belt which separated it from the Atlantic. The Isthmus of Panama was as unknown to the white man as Central Africa. In 1849 an Irish adventurer had announced to the world that he had traversed the Isthmus repeatedly and that only "three or four miles of deep cuttings were necessary to make a practicable ship canal from the Atlantic to the Pacific." Indeed, a book was written on the subject and something of a world sensation resulted. A company of English capitalists, aroused to action, even dispatched to the jungles of Darien a civil engineer by the name of
Grísborne, with instructions to verify the report. Just how far he penetrated inland will never be known but a few months later he returned to Europe with the written statement that "it was barely thirty miles between tides" and that the "summit level of the Isthmus was only 150 feet."

Infused by the announcement, France, England, New Grenada, and the United States promptly organized a series of expeditions for a thorough survey of the territory. Of the exploring parties, however, only one achieved its mission. This was the band of pioneers who flew the American flag. Their itinerary began at a point on the shores of Caledonia Bay and ended at the Gulf of Darien—a path which had not been traversed by the foot of a white man since the year 1788.

There were those in plenty who had attempted it, for even then the tales of jungle-treasure had thrown a magic allurement over the Panama wilderness, but none of the gold-seekers had lived to tell the tale. Whether they had met death from the arrows of hostile Indians, whether the poisonous fever of the Isthmus had crept into their veins, or whether they had fallen victims to the prowling beasts of the forest, the coast settle-
ments never knew. The veterans of the tropics shrugged cynical shoulders—and gave the Panama jungle a wide berth.

This was the wilderness into which Strain and his gallant party plunged on the morning of January twentieth. The band was equipped with provisions, calculated to last for ten days, if used with caution. It was to be in every respect an expedition of peace so far as was practicable. Each man was equipped with but forty rounds of cartridges.

From the outset Strain insisted on assuming the heaviest burdens of the party and was noticeable by a heavy field-glass swung over his shoulders. Similar expeditions at the four points of the compass had made the Lieutenant not only a daring but an experienced woodsman. Under his outer shirt he wore a second shirt of linen—with a shrewd remembrance of the invaluable qualities of the material as bandages in bullet wounds. But the secret of the linen shirt he kept to himself until it was called into use.

The earlier route of the party followed closely the winding banks of the Caledonia River. Almost from the beginning, frequent indications of lurking Indians were found. During the second day's march, abandoned native huts and dugouts
Lieutenant Isaac C. Strain—Hero

were discovered, with every indication that their owners had deserted them at a moment's notice. To a man of Strain's experience these facts pointed unerringly to the uncomfortable conclusion that the Indians meant to fight—and fight promptly.

When the reader—snugly established in his armchair, I hope—recalls that even to-day two thirds of the Panama wilderness has never been explored, he can appreciate the gravity of Strain's position. But the Lieutenant was not a man to be daunted. If he examined his rifle more closely, he pressed onward all the more resolutely.

To make matters worse, the disagreeable conviction was pressing itself upon him that the river route he had mapped out was impracticable. Before the party towered the dark, rocky Cordilleras. The Americans had conjectured that the Caledonia had ploughed a channel through the mountains and, if they followed it far enough, they would find a trail blasted by Nature. But even to inexperienced eyes it was becoming plain that, if this were true, the route was barred to men.

It was a grave step to plunge from the banks of the river into the heart of a trackless wilderness. But when Strain gave the order which changed the course of the party, there was not a murmur. Indeed the men essayed a cheer. They were
soldiers and sailors of fortune, who had looked upon the bright face of danger so long that it had blinded them. They were used to the hazards of the enemy's country and before the first day of their new route had drawn to a sullen close they realized that they had invaded it.

On every side were evidences of hostile Indians. The more advanced of the party even fancied that they could see dark, stealthy forms in the brush, and weapons, which until now had been swung carelessly over their shoulders, were abruptly transferred to alert, nervous hands. The evening camp was pitched in a circle of restless sentinels. The night was broken with a succession of muffled alarms and twice the party sprang from their blankets to repel a fancied attack. Morning broke over a group of haggard faces. The menace of the invisible enemy was wearing even on nerves that had survived a score of open battles.

If the Indians intended to attack, why the delay? The strength of the Americans surely was apparent to the roving eyes behind the dark fringe of trees. It was this last thought which brought the cold sweat to Strain's brow. Was it possible that the savages had cut off their retreat and were suspending hostilities because their ad-
A PANAMANIAN "WASH LADY"
vance was bringing them nearer to the Indian villages and so to the heart of the trap they had blindly entered?

For another day and night the situation continued without a change. Strain realized that their only hope was in a straight path ahead in spite of its dubious ending. To change their course or to attempt a retreat would be to invite instant destruction.

It was early in the following morning that the party confronted the apparent crisis of the situation. Directly in the path ahead the Americans saw a group of five Indians advancing toward them at a rapid trot. They were armed to the teeth, and Strain's first impulse was to give a quick order to fire. If he had done so, it is probable that not one of the expedition would have seen another sun set.

As it developed later, the white men had been between two hostile war parties for twelve hours and the fact, instead of proving a double peril, was really their salvation. The Indians represented two tribes between whom the hatchet had not been buried for a generation. The presence of the Americans had kept them from flying at each others' throats, and the spectre of the feud had saved the Americans in their turn from a
shower of arrows. The last day's march had taken the expedition out of the territory of the first tribe. The natives now advancing toward them hailed from the coast and were shrewd enough to see that their profit lay not in attack but in friendship. Undoubtedly the white men would be willing to pay a high price for guides. Probably their friends also would be grateful and generous. Why not earn their rewards instead of courting their vengeance?

It was a heartfelt sigh of relief that Strain breathed when he learned the Indians' mission and acceded to their terms. His high hopes, however, were doomed to a bitter collapse. For two days their progress showed no discouraging feature. On the second evening their guides met another party from their tribe and a spirited conference followed in their native tongue. The Americans never learned its exact details but, at its conclusion, the attitude of the Indians changed completely. Beginning with the third morning the native guides maintained a pace so sharp that it was only with the utmost effort that the white men could keep them in view. Several of the party already were beginning to yield to exposure and fatigue, and when the evening halt at last was reached they were exhausted com-
pletely. To add to the sombre outlook only one
day’s provisions remained, and the Indians
refused point-blank to replenish the larder. The
secret of the natives’ changed attitude has never
been explained. Whether the newcomers had
persuaded the guides to abandon the white men
and later return to their attack or whether the
Indians threw up their task in disgust under the
jibes of their companions will always be some-
thing of a mystery. For another day the natives
held their posts, maintaining the same man-
killing pace. So difficult was the path that
although both red and white men put forth their
hardest efforts, a distance of only twelve miles
was covered in as many hours. Early the next
morning the guides disappeared entirely. The
party was deserted in the heart of an unknown
wilderness with no food, shelter, or map, and with
more than half of their number alarmingly ill.

Strain ordered a halt and called a council.
The group of ragged men realized that they had
to prepare for a hand-to-hand grapple with death.
A short distance to the rear they had crossed a
stream which Strain believed to be the Iglesias.
Forty miles ahead—or more—lay the Savana.
If they could reach the latter stream, they would
find white settlements and friends, but the inter-
The Conquest of the Isthmus

vening route extended through one of the most tortuous mangrove swamps in the world. They could depend on neither water nor game at any point of the journey, and without both the goal was clearly beyond their physical powers of endurance. Only one course remained. This was to follow the Iglesias until it emptied into Darien harbor. As Strain cast his eyes over the exhausted group, he realized that many could never reach the journey's end alive. But even his gloomy forebodings did not picture the ravages which privation was to make in the ranks before him.

As it developed, it was not the Iglesias but the Sucubti River which the party had struck, one of the most important streams in Central America, although hitherto it had not been indicated in any map of the Isthmus. For eight days the expedition forced its way through the jungle, subsisting on nuts and the occasional birds which the more expert marksmen were able to wing. Their clothing hung in tatters and their bodies were a mass of swollen sores. Their peculiar nut diet had brought on severe internal cramps and loosened their teeth. On the third day they sought to make a short detour at a bend of the river and lost the stream altogether. For two
days they hacked their way through the underbrush before they reached water again. This time it was the Chuqunaqua River which they found, perhaps the most treacherous and tortuous stream from Nicaragua to Colombia. Its steep, winding banks greatly increased the difficulties of their progress. Once Strain endeavored to build a raft in the hope of its carrying the weaker members of the expedition to the coast. When the project was finally accomplished, the current wrecked the flimsy structure within an hour of its launching. The plan which had been vaguely forming in Strain's mind for some days now took definite form.

It was hopeless to expect to reach a settlement at the pace they were making. At most the party could not accomplish more than five and six miles in a day's journey. Was it possible for two or three of the stronger men to push on ahead and send back a relief expedition? Strain did not make the plan public until he was convinced that it was their only hope, and then he put it in the form of a suggestion, offering himself to share the danger and responsibility of the advance party. Several of the men at once stepped forward as volunteers, and from the number he selected three who had shown the greatest strength and endur-
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ance. He did not try to soften the perils before them. By this time every member of the expedition knew that the issue of life or death was only a question of days. If Strain could reach the coast there was a chance of rescue. But no one knew the odds against him better than the men he was seeking to save.

Strain placed Truxton in command during his absence, paused for a few moments’ final leave-taking, and then plunged resolutely into the dark fringe of underbrush before them. This was on the thirteenth of February. Thirty-nine days were to pass before he saw the party again.

The privations which followed are almost beyond belief. Here are random extracts from the official diary of Truxton’s command:

“March 2.—Several of the men found under their skin to-day a singular species of worm called by the natives ‘Gusano del Monte’ (worm of the woods). It was covered over like a blind boil and grew rapidly, attaining a length of one inch. When it was in motion it was extremely painful. The party subsequently suffered very greatly from these pests, and in many cases were obliged to have them removed by a surgeon after the journey had terminated.

“March 3.—Early this morning Lombard, Parks, and Johnson left the camp without permission, and
when it was found that they had taken their blankets and cooking utensils, it was supposed they intended to desert and try to regain the ship by making their way back up the river. After an absence of two or three hours, however, they became frightened and began firing signals of distress. Truxton, however, for a long time left them to wander about. At last he ordered their signals to be returned, and they came into camp alarmed beyond measure and most penitent. They confessed that they intended to hide away until Holmes (who was dying) was buried and then dig up the corpse and fill their haversacks with the flesh.

"Sunday, March 5.—We have now been waiting twenty-one days for Lieutenant Strain's return and the conclusion forces itself upon us that, if he with three strong men could not reach the settlements in this time, our suffering, debilitated party of sixteen could never get through. A council of the officers, therefore, has been held and we have determined to make our way back up the river and seek to regain the ship. To push on is madness. Whether Strain has perished from hunger, has been devoured by wild beasts, or slain by Indians can only be conjectured."

The following two weeks were a veritable Inferno. Holmes was given a rude burial, followed in a short time by that of Castilla and two days later by the death of Polanco. The latter
occurred among heart-rending circumstances. When his illness reached the point where he could no longer continue the journey, a council of war was held and the question was argued whether the life of one man who could not survive more than a few hours should be placed before the lives of his fourteen companions. Under the conditions it was deemed necessary to leave Polanco to his fate. Three times Truxton went back to bid him farewell and at last with streaming eyes gave the order to advance. How long Polanco lay in the rough clearing was never known, but it was afterward found that he had succeeded in crawling back to the grave of Castilla where death finally overtook him.

Lombard, the boatswain, was the next man to go. When it became evident that he could advance no farther, he asked that a fire be kindled and a knife and hatchet given him. They left him sitting back against a tree with the river whirling at his feet. How or when he met death was never ascertained.

Here is a vivid account of the last days of the expedition, in those hours when the death of all seemed certain. The extract is taken from an article by J. T. Headley, published in Harper's Magazine shortly after the events described.
"It was not death they feared: it was the desolate fate of being left alone in the woods that made them try to march. Again and again a poor wretch would sit down declaring he could go no farther; but as the forms of his comrades vanished in the forest, he would struggle up and stagger after them. The weaker they grew, of course, the less able they were to get food and thus hunger and weakness acted on each other.

"Some of them even wished they might get an Indian to eat; and though the horrible thought may have occurred to some of devouring each other, it found no outward expression; nor could it, for, still true to their high obligations, the officers retained their lofty character and through it their supreme authority.

"Nothing more vividly illustrates the terrible straits to which they were reduced than the following incident. Truxton, one day in casting his eyes on the ground, saw a toad. Instantly snatching it up, he bit off the head and spitting it away, devoured the body. Maury looked at him a moment and then picked up the rejected head, saying, 'Well, Truxton, you are getting quite particular. Something of an epicure, eh?' With these words he quietly devoured the head himself.

"After his return, a friend in questioning him about the incident said, 'Why, Maury, I thought the head of a toad was poisonous.' 'Oh,' he replied,
'that is a popular fallacy, but it is devilish bitter!'

"To a mere looker-on the camp on that last night would have presented a most heart-rending spectacle. It was plain that only two or three could reach the banana plantations toward which they were struggling, while four or five must be left alone in the jungle to starve or to die. Three knew that their fate was sealed and looked forward to their abandonment with a calm, stern eye. Their young commander, Truxton, would in all human probability never lead them again. Weighed down with the terrible responsibility of so many lives resting on his exertions, he had borne nobly up until the sudden attack caused by eating some unknown berries. As he lay with his head resting against the root of a tree, his clothes in rags, his face wan, his dark eyes sunken, while the blood streamed from his hands which the thorns had pierced—he presented a spectacle that would draw tears from stones. Boggs, a young man of fortune, who had joined the expedition as an amateur, lay near him. It was plain that he had made his last march. He was engaged to a girl in Illinois and visions of her kept hovering before him.

"A few steps off in the men's camp, the spectacle was still more harrowing. Some were sitting on the ground with their heads doubled to their knees so that the pressure would relieve the gnawing pain in their stomachs, while others were lying flat on their backs staring up at the sky. Harwood, a young man,
twenty-two years of age, was doubled up, a mere
bundle of rags, his neglected hair streaming over his
shoulders, giving him a weird, unearthly appearance.
He knew that his marching was over. Beside
him in the same position and almost naked, sat
another young man, Miller, who was also to be left
in the morning. A short distance from these sat
Harrison leaning against a tree. He was a tall,
powerful man, but now wasted to a skeleton and
only half covered by his rags. He had been one of
the best men in the party, but starvation had done
its work and he had taken his last step toward the
banana plantations. A little farther off lay Ver-
milyea, with his skeleton arms flung out upon the
ground, from which he could not rise even to a
sitting position. A settled gloom, a chill despair,
an appalling resignation characterized each man.

"Just as night was descending over the forest, a
report like that of a musket was heard down the
river. Maury, who was sitting near the shore,
shouted, 'Truxton, I hear a gun. Shall I fire?'
'Yes,' replied Truxton without stirring. 'But I am
not loaded with slugs.' 'Never mind,' was the weak
response. 'Fire away.' In a few moments Maury
exclaimed again, 'I see boats and Indians.'

"Then again, 'I see boats and white men,' and
still again, 'I see boats and Strain!' The expedition
had been saved at that moment when the fate of
all had seemed to be sealed."
The Conquest of the Isthmus

Strain's battle with the wilderness in search of a relief expedition represents an achievement almost more than human. It was only his indomitable will which kept the little party alive. The latter part of the journey was made on a raft. The structure was wrecked on a mass of driftwood near the river's mouth and the intrepid Americans finished their trip on a log. When the coast settlement of Yavisa was reached, Strain was so exhausted that he had to be carried from the river.

Of the twenty-seven men who composed the party, one third died from exposure and privation. Of the remainder fully half carried the effects of the terrible ordeal to the grave. Lieutenant Strain, in his report to the Secretary of the Navy, says that the expedition was "without brilliancy, because without success." From an official standpoint the report was true. The survey of the Isthmus, which it had been hoped to accomplish, was impossible. But a greater evidence of unselfish heroism in the face of peril and privation has never been recorded in the annals of American history. The expedition effectively exposed the false reports which had been given to the world regarding Panama and showed for the first time the true character and extent of the
wilderness which covers the neck of the American continent. If a more positive result were not achieved, the failure was not due in any sense to the men who helped blaze the way for the greater triumphs of the twentieth century.
CHAPTER XIV

THE TRUTH ABOUT THE GATUN DAM

THE smile of William Howard Taft, forty-seventh President of the United States, is of large proportions. Also it is thoroughly hearty and genuine, expansive but never thin. It was in vivid evidence at the Culebra Y. M. C. A. building during his Isthmian visit of February, 1909, when the President in his address to the men of the Panama Canal reached the subject of the much-assailed Gatun Dam. Behind the smile there was a story, one of the few that President Taft tells in public, and behind the story there was a characteristic summing up of the truth about the Panama Canal:

"In my early days at Cincinnati there used to be a judge," related Mr. Taft, "who once remarked to a lawyer arguing a certain case before him, 'You have stated that point to me twice. Now please do not repeat it again.'"
The Ruins of the Panama of Four Hundred Years Ago
The Truth about Gatun Dam 199

"'But, your Honor,' protested the lawyer, 'I want to make myself clear.' To which the judge with some asperity replied, 'Down in my country they say that a good judge can digest an argument after it is presented to him once. If he is a little dull it may take twice to make him comprehend, but when you give it to him a third time he receives it as intimation that you think he is a fool!'

"Therefore I repeat that the people of the United States are not excited by the headlines in the newspapers that the Gatun Dam is falling down, or anything of the sort. They are determined to have the Canal built. They are willing to spend the money to do so. And they believe in the men who are doing the work. To try to convince them that the Canal is wrong and the men behind it wrong is to assume that like the judge in the story they are thorough fools."

Which expresses the problem of the Gatun Dam in a nutshell. As a matter of fact there is no problem. The charge that the project is impracticable, that the dam is undermined by a subterranean lake, is not only the veriest nonsense but a malicious falsehood.

Here is the angle from which John F. Stevens, formerly chief engineer at the Panama Canal, views the broadsides of yellow journalism that have been hurled at Gatun:
"The animus of the attack lies deeper than any alleged fears as to the practicability of the proposed dam or locks. A suggestion in the newspaper that was at the head and front of the agitation that the whole work had better be dropped and the money already spent charged up to 'profit and loss' is very significant. Once such action were taken, the Nicaraguan scheme would come to the front again, backed by all of the powerful influences which before tried to foist it upon the American people for reasons not hard to understand.

"The question of the advisability of building an Interoceanic Canal has nothing to do with the matter. The people have decided that they want the Canal, and they are ready to pay for it. The choice of the location has been wisely made and the work properly planned. It is in competent hands and is being executed with a rapidity that surprises even its friends. The thing to do is to extend to Colonel Goethals and his assistants all the encouragement and moral help possible. The engineering world will have every reason to be proud of the result when it is an accomplished fact."

We have heard much of the Gatun Dam from the engineer's standpoint, from the muck-raker's
The Truth about Gatun Dam

standpoint, and from the politician's standpoint. What are the central, vital details from the standpoint of the average American citizen who does n't know anything about the engineering technicalities and does n't care anything about the muckraking broadsides? Behind the mass of blue-prints and charts what are the plain facts that enter into its construction?

As a foundation, we have the initial statement that the great mass of earth and stone, which we call the Gatun Dam, will shelter the largest artificial body of water in the world, measuring 167 square miles. On its surface the world's mightiest vessels of peace and war may be expected to gather. On this inland sea, created by man's ingenuity, a fleet will be able to anchor with as much ease and safety as in the largest harbor in the world.

It will need tens of millions of dollars, tens of thousands of men, and years of the most patient and exacting labor to accomplish this achievement. It is a bald statement to say that the project will be one of the engineering marvels of history. Perhaps a generation ago it would have been deemed impossible. Yet the twentieth century engineering expert shrugs his shoulders if you suggest the difficulties of the project. He will tell
you that it is just a question of money and men and time. As for the rest it is merely a matter of following one general policy as plain to the engineer as the printed page is to the layman. As a matter of fact the Gatun Dam presents fewer problems than the metropolitan sky-scraper does to the architect. When completed the dam will be a huge embankment 7700 feet long—nearly a mile and a quarter,—half a mile wide at the base, 90 feet high, and tapering to a breadth of 100 feet at the top. These are big figures in fact as well as on paper. But the veteran engineer digests them without a quiver of an eyelash. They are only the dimensions of a mass of earth and stone and cement long enough and high enough and firm enough to hold back the pressure of water against it. It will be built almost in a straight line. The earth beneath is solid. There are no ugly hollows nor treacherous swamps. Certain sensational newspaper writers have said that a vast subterranean lake exists under the ground and that the whole structure might crumble into its depths without warning. The engineers at Panama, however, do not even reply to this charge now. "If there is such a lake," argues the bronzed man in white duck who has been solving the engineering problems of the
Canal for five years, "don't you suppose I would know more about it than a newspaper man? And if I knew there was such a lake, do you suppose that I would ruin my reputation by going ahead on a line that would end in failure? And again, don't you give me the credit for a small degree of patriotism? Do you think that I would want my country to spend millions of dollars in a project that might collapse before it is completed? The charge that there is a subterranean lake under the Gatun Dam is not only a ridiculous statement but a malicious one. The whole project reduces itself to the question of building a solid embankment on solid ground. The Singer Building in New York is regarded as an architectural wonder, but after all the problem of its construction was merely that of putting one story above another on a firm foundation. That is our only problem at the Gatun Dam, that—and harnessing the Chagres River."

Here we have the most puzzling factor at the Panama Canal. The Chagres River is at once the greatest boon and the greatest drawback which the engineers are facing. Without it the present course of the Canal would be almost impossible. Like dynamite, however, it is an agency which may be just as powerful for evil as
for good. The difficulty does not lie in utilizing the Chagres River but in controlling it after it has been put to work. Unlike man it does not measure a day's work by the union scale, and having accomplished a certain task, takes particular delight in tearing it to pieces. It is not a well behaved stream in any sense of the word. It refuses even to stay where Nature has placed it. Every few months it rises in a rage and sweeps over its banks with a fury which on certain memorable occasions has not abated until the surrounding territory for miles has been deluged with angry, swirling waters. At Gatun it has even attained a volume as large as that of the Great Falls of Maryland. And then when it subsides it goes to sleep and its current dwindles almost to nothing. For months it seems to share the stupor of the tropics, hardly mustering energy enough to reach the Caribbean. During these periods it is the laziest stream from Nicaragua to Colombia. The problem, therefore, of keeping the Chagres River at steady, systematic work is a difficult one. And the success of the Canal depends largely on its solution.

In a paragraph the plan of the Canal-builders is to dig a straight channel 5000 feet wide and 40 feet deep from the Atlantic coast to Gatun, where
The Truth about Gatun Dam

A system of three locks will lift vessels to the 85-foot level of the great inland lake, which will be formed by the Chagres River when it is turned from its present course at this point. The Gatun Lake is three miles from the Atlantic coast. It will carry vessels for the next twenty-five miles of the interoceanic voyage, which brings them to Las Cascadas. Here they enter the Culebra Cut, the only point where the route becomes in a technical sense a canal. This section continues for seven miles, when the vessels are lowered to a second lake at Miraflares, formed by two dams of which the largest is located at La Boca, almost within the shadow of the Pacific. This latter lake is five miles in extent. At Miraflares are located two duplicate locks for conducting the vessels through the last stage of the journey to the waters of the western ocean. The Isthmian waterway is just forty miles in extent, five eighths of which will be furnished by the waters imprisoned by the Gatun Dam, in other words, the Chagres River under harness.

The Gatun Lake will never be less than 42 feet in depth along the ship route, and for the first sixteen miles its navigable width will exceed a half a mile. In the next nine miles, its width diminishes gradually to 300 feet, and when it
reaches the Culebra Cut the width at the bottom will be only 200 feet. The entire canal, however, will average a width of not less than 500 feet.

The Gatun Dam will consist of two great piles of rock 1200 feet apart and rising to a point 60 feet above mean tide. The intervening space will be filled by earth and stones deposited by giant hydraulic machines. In addition to the Chagres River the ground to be covered by the dam is crossed by the watercourses of the old French Canal and the West Diversion. It was at the former that the stories of the instability of the project had their birth.

The south rock pile was being constructed here in the early part of November, 1908. A newspaper correspondent on his way from Colon to Panama noticed a group of engineers and workmen gathered about the vicinity with an air of unusual excitement. The Chagres River had been in a flood stage for several days and a portion of the railroad track was temporarily under water. When the train was halted the newspaper man strolled over to the scene of activity.

A portion of the dam had slipped back owing to a slight settling of the ground beneath. This was the fifth slip which had occurred since the
work of construction. The others, however, had been deemed too trivial to cause concern and had been overcome with a few days' labor in readjusting the slope of the masonry. The reporter, however, saw an opportunity for a sensational cable dispatch. It had been only a few days before that the story of the underground lake had appeared. What more logical than the theory that the whole dam was slipping down into the mysterious subterranean pool? This was the argument of the reporter. When he walked into the cable office it was with several pages of closely written manuscript. The next day the nation was ringing with the news that the Gatun Dam was a wreck. Before an official denial could be printed, the slip at the French Canal had been repaired and the men on the job had forgotten all about it.

As a record of history, it is on such trivial incidents as this that most of the muck-raking charges against the Panama Canal have been founded. One American writer who has been most prolific and stubborn in his cries of failure proved himself unable to distinguish a dredging machine from a steam shovel.

The truth is that the charges against the Gatun Dam have been made by those who either do not
know the real facts or do not want to know. The men who know the situation, and are qualified to discuss it intelligently and fairly, endorse the project without reservation. The American people may rest assured that the engineers in charge of the Panama Canal, who have pledged their words to the nation that it not only can be dug but will be dug, are worthy of their deepest confidence and support. The muck-raker is entitled to a hearing when he has the truth on his side. Indeed he should be supported whether he strikes at the government or at the individual. But when he has n't facts or even shreds of facts to support his charges, and in the face of the world tries to riddle his country's cause, he is open to the suspicion that he would sell his nation's honor as quickly as he would his own.
CHAPTER XV

IS IT ALL WORTH WHILE?

WHAT is Uncle Sam really to gain from the Panama Canal? In dollars and cents, how is this $400,000,000 or $500,000,000 investment to pay? When the Canal finally is completed—what?

In the record of the world’s great waterways, the Suez Canal is a triumphant success. In cold figures, it has cost $100,000,000. In an average year, its gross revenues amount to twelve per cent. of this expenditure. In other words, the investment yields a return of $1,000,000 a month. In one year, 4000 vessels with a combined tonnage of 15,615,309 pass through the waterway.

The most conservative prophet will admit that Panama offers far greater commercial possibilities than will ever be attained by the Suez route. But this is not to say that the Panama Canal is or will be the greatest in the world—from a financial viewpoint. Such a rose-tinted assertion must be shattered in the beginning.
The Conquest of the Isthmus

It will pay. This is not fairly certain, but absolutely so. How much or how soon are questions which cannot be answered definitely. On an investment of $400,000,000 a six per cent. return would mean a yearly income of $24,000,000—double the total receipts from the Suez Canal. Even a ten per cent. profit, however, could not equal the returns from the famous "Soo" Canal, which, as the throat of the Great Lakes, swallows more millions, both in tonnage and dollars, than ever can be possible at Panama. This from the standpoint of the investor. It is from the standpoint of the public that the real possibilities of the Panama Canal are most vividly silhouetted.

The Suez Canal was built frankly to make money. Back of it is a private corporation shrewd enough and strong enough to demand from the golden stream of the world's commerce an enormous profit. The Panama Canal is to be viewed from an exactly opposite angle. It is not being constructed to provide a gigantic revenue either for a private corporation or for the Government. Its primary object is essentially one of public service. Its central purpose is the promotion of American industry and American commerce as factors in our national development. If it never paid more than operating
expenses to the Government, the project would yield an incalculable return in the new industrial epoch it will mark.

The Panama Canal may be operated on one of four policies. A toll rate may be charged large enough to return to the Government not only its original expenditure but a profit on the investment. Again this toll may be reduced to a point barely large enough to create a sinking fund, which in time may balance the vast expenses of the undertaking. Still again the Government may not seek reimbursement for the cost of construction, but may endeavor merely to cover the operating expenses. As the last and probably the least likely policy, the Government may remove the Canal entirely from tolls, and leave it free to our own nation if not to the world.

As a problem in multiplication, suppose we institute a toll rate of one dollar a ton at the Panama Canal. This would be quite reasonable. Indeed we could increase it to a dollar and a half without being exorbitant. In one year we may expect that a tonnage of from 4,000,000 to 10,000,000 will pass through the great waterway. In course of time it will be much more, and far greater than the records of the Suez Canal. We are dealing now, however, with the facts which
we may expect within three or four years after
the opening of the Canal. On a tonnage of 6,000,-
000 we could anticipate then a revenue of $6,000,-
000. Within ten years this could well be doubled.
If the Canal were the property of a private cor-
poration, a toll of at least a dollar and a half
would be charged, and the project could be ex-
pected to yield within ten years a profit of from
four to five per cent.

Half of the population of the globe live on the
Pacific Ocean, to which the Panama Canal will
be the most direct and feasible gateway. This
is a commercial fact, whose possibilities the world
cannot measure—yet. And the Canal is to be
viewed from yet another angle. It will be a
part of the North American coast line, affording
the first water communication we have ever had
between our Atlantic and Pacific States without
rounding South America. The Panama Canal
will tap five main arteries of commerce—
Atlantic North America, Pacific North America,
Pacific South America, Australia, and Eastern
Asia. Between many of these markets, high
freight rates and long water routes have built
almost impregnable barriers.

For example, from New York to San Francisco
by water is now a journey of 13,714 miles through
the Straits of Magellan. The Panama Canal will reduce this by more than half, to be exact effecting a saving of 8415 miles. From New York to Yokohama by way of the Suez Canal is a distance of 13,564 miles. By way of the Panama Canal it will be lessened to 9835 miles. From New York to Guayaquil is now a journey of 10,425 miles. The Panama Canal will lower this figure by more than three fourths, reducing it by 7561 miles.

Curiously enough it is farther by water from New Orleans to San Francisco than it is from New York owing to the winding route through the Gulf of Mexico and along the northern coast of South America. At the present time it is a distance of 14,114 miles. The Panama Canal will reduce this to 4698 miles. From New Orleans to Yokohama is now 14,929 miles. By way of the Panama Canal it will be lessened to 9234 miles. Compare the distances to Australia. When the Panama Canal is completed, the present water route from New York to Sydney, Melbourne, and Adelaide will be decreased from one fourth to one third.

A new map, geographically, commercially, and financially, will be traced by the Big Ditch at Panama. How it will pay is much clearer than
The Conquest of the Isthmus

how much it will pay. In the foreground is the cyclonic boost which it will give the American cotton and iron markets. The Southern cotton growers now reach the Asiatic ports by the cumbersome route of the Suez Canal via New York. Zigzag routes and smothering freight charges are devouring the item of profit. Europe, with the key to the situation, is turning it slowly in the lock against American competition. The Panama Canal would revolutionize these conditions with the wrench of a Kansas cyclone.

South America spends $86,000,000 each year for cotton. Only five per cent. of this amount goes to the United States. The remainder is cornered by the European exporters who hold the west coast of South America practically at their mercy through the lessened expense of transportation. Here again the Panama Canal would reverse this situation like the change of slides in a stereopticon.

Cotton is one of the greatest of our products. Ever since the dream of Eli Whitney became a reality, cotton bales have been rising to a higher and higher pinnacle on our financial horizon. Of recent years men have learned that our cotton development is being smothered, that our market is not keeping pace with our production. The
cotton growers of Europe, often with a less investment and less expenses, are gathering greater returns than the American planters, who moreover are not putting forth their full efforts because of the handicapped market they are facing. South America would use our cotton in preference to that of Europe, but it is not going to pay more. Europe sends her cotton through the Suez Canal with a transportation charge reduced to the minimum. We have to send our cotton either down around Cape Horn or follow laggardly in the footsteps of our European competitor through the Suez Canal. With a freight expense three and four times greater than his, competition is absurd.

Iron can be produced more cheaply at Birmingham, Alabama, than at any other point in the world. Here again the barrier of transportation closes the great South American and Asiatic markets. The Tennessee mills produce machinery of almost every pattern, machinery with a worldwide reputation, but it is out of the question for us to carry it to the countries of the Pacific in the hope of out-bidding Europe. The Southern States centre a large share of their manufactures on the steel and hardware industry. Their hardware is so good that we have long known the Pacific market would jump at it, if we could bring it
within the other fellow's prices. But we can't. We have to go double the distance, and add a freight charge heavier than the cost of production. If South America and Asia were thrown open to our Southern mills, their output would be doubled. This is impossible now. In the Panama Canal lies the magic wand which will make it possible.

The Big Ditch at Panama will solve the forestry problem—from one point of view. Vast forests sweep the Western coast, in which one of the greatest supplies of building lumber in the world is located. It is beyond our reach now, at least beyond the reach of the Eastern markets, because of the excessive freight charges. Consequently we have to view it as something unattainable. The cost of water transportation is one fifth that of overland transportation. With the ocean itinerary opened by the Panama Canal, the East will be for the first time able to reach the Western lumber, and another segment of the industrial revolution will be unfolded.

Indefinitely the commercial field of the Panama Canal could be lengthened—to the items of coal, fruits, cereals, fish, grain, manufactured goods in general and particular, and even the broadening possibilities before the American ship builder.
Is It All Worth While?

With an inland canal from the Great Lakes to the Mississippi, and the deepening of the passageway to the Gulf, the dream of an ocean greyhound floating majestically southward from Duluth to Colon, and thence through the Panama Canal to the countless ports of the Pacific, is easy of accomplishment.

And who can measure the golden trail in its wake?
APPENDIX

As the latest full and authoritative account of the progress made in digging the Panama Canal, the subjoined report should prove of the first interest to all who are curious regarding the colossal task now in process of accomplishment on the Isthmus.

FULL TEXT OF THE REPORT OF THE SPECIAL BOARD OF ENGINEERS SUBMITTED TO CONGRESS BY THE PRESIDENT

WASHINGTON, February 16, 1909.

SIR: In accordance with your instructions, we have visited the Isthmian Canal, in company with Hon. William H. Taft, and have examined the work in progress and the plans for the structures as far as now developed.

We have given especial consideration, under the instructions of Mr. Taft, to the foundations for the Gatun Dam, and the feasibility of constructing and maintaining thereon a safe dam for retaining water at 85 feet above sea-level.

We have examined the slides in the banks of the Canal and the surveys, plottings, and sections that have been made of them. The subsidence in the fills in the toes of the dams and in the railway embankments has also been examined, and we have considered the effect of the qualities of materials
thus disclosed upon the construction of the various works and upon their ultimate stability.

We have also considered the evidence that has been accumulated as to the permeability of the different materials and the possible loss of water by percolation through the bed and banks of the future Gatun Lake; and the question whether such loss of water by seepage would result in materially reducing the water supply or in undermining and ultimately crippling the structure.

GATUN DAM

The Gatun earth dam is the central point of discussion, and we were instructed by Mr. Taft to give it first consideration in the light of all new evidence.

We are satisfied, both from the records of the experiments that have been made and from our own personal examination of the materials, as seen in cuts now open and as disclosed by samples from test borings, that there will be no dangerous or objectionable seepage through the materials under the base of the dam, nor are they so soft as to be liable to be pushed aside by the weight of the proposed dam so as to cause dangerous settlement.

We are also satisfied that the materials available and which it is proposed to use are suitable and can be readily placed to form a tight, stable, and permanent dam.

The type of dam now under construction is one which meets with our unanimous approval. It is a combination of rock fill and hydraulic fill, in which the exterior faces are to be composed largely of rock of all sizes obtained from the canal excavation, dumped
and laid on slopes much flatter than are ordinarily found in earth dams, while the interior of the great mass will consist of clayey material obtained by hydraulic dredging from large deposits at a little distance from the dam and carried by water through pipes to the places where it is to be used. The material as delivered is a mixture of earth and water. The material held in suspension slowly deposits, finally forming a solid, water-tight embankment. The pond necessarily maintained on the top of the dam during construction tests the embankment at all stages of its growth, searches out any weak points, and leads to the closure of any voids or cracks.

The most practical question in the construction of the Gatun Dam is the possible slipping and sliding of the materials underneath and in the body of the dam. The materials, speaking broadly, are of a clayey nature, generally impervious to water, but sometimes slipping when subjected to heavy unbalanced pressure or on high steep slopes when saturated with water. In this respect the materials differ radically from the sandy and gravelly materials which have been frequently used in the construction of other earth dams.

In order to build a dam of these clayey materials that will be stable and permanent, it is necessary that the slopes should be flatter than would be needed to secure the stability of a dam of siliceous, sandy, or gravelly materials.

The evidence that has been accumulated as to the degrees of slope that are stable with these materials seems to us conclusive. The fact that the materials are slippery does not mean that a dam built from them is necessarily less stable than a dam built of
materials that do not slip so easily. It does mean
that, in order to secure stability and permanency,
the dam must be built with a greater thickness at
the bottom.

The dam as proposed is more than a third of a mile
in horizontal thickness at its base, including the
rock-fill portions.

The design upon which the work is now being prose-
cuted abundantly fulfils the required degree of sta-
bility and goes far beyond the limits of what would
be regarded as sufficient and safe in any less impor-
tant structure.

As a matter of convenience and economy during
construction, materials have been piled up on slopes
much steeper than those contemplated in the finished
work. Generally, the materials so placed have re-
mained in position, but in some cases slips have oc-
curred. The occurrence of these slips is of no serious
consequence either in the practical execution of the
work or in the ultimate stability of the structures.
We can readily understand how incorrect deductions
may have been drawn from these occurrences, espe-
cially by those not fully informed as to the character
of the materials and the ample dimensions and much
less steep slopes of the proposed structures in their
final form.

We were requested to consider the proper height
for the crest of the Gatun Dam, and after considera-
tion concluded that it could be safely reduced 20 feet
from that originally proposed, namely, to an eleva-
tion of 115 feet above sea-level, or 30 feet above the
normal level of the water against the dam. We are
also of the opinion that the sheet piling recently pro-
posed under the base of the dam may be safely omit-
ted. The narrow cut-off trench now in progress through the upper earth stratum on Gatun Island and elsewhere and designed to be refilled with sluiced material should be continued.

Changes in these respects will facilitate the work of construction and will reduce somewhat the cost of the proposed work.

A full study of all the data at hand, and of the materials, and of the plans that are proposed with the above modifications, leaves no doubt in our minds as to the safe, tight, and durable character of the Gatun Dam.

CHANGES IN PLAN OF CANAL

It was suggested to us by Mr. Taft that we give special consideration to those changes which have been made in the plans of the minority of the Board of Consulting Engineers of 1905 since the adoption of the project.

Change in Position of Lower Pacific Locks

One of the most important of these changes is the moving of the lower locks on the Pacific end of the Canal from La Boca, on the shore of Panama Bay, to Miraflores, about 4 miles inland.

This change involved abandoning the construction of two earth dams at and near La Boca and the substitution of about 4 miles of deep-sea level channel 500 feet wide from La Boca to Miraflores in place of a wider channel through the lake that would have been created by the dams.

Before this change was made work had been commenced upon the toes of one of the dams. The
material had been piled up to a considerable height on
slopes steeper than were capable of being supported
by the underlying material. Under these conditions
settlements occurred with lateral displacement of
some of the underlying material. Your board, after
carefully inspecting the ground and the partially
completed work, is of the opinion that these settle-
ments cause no reason to doubt the stability of the
proposed dams. We are unanimously of the opinion
that stable and water-tight dams of substantially the
proposed dimensions could have been constructed on
the proposed sites without recourse to dredging out
the underlying soft material.

The report of the minority of the Board of Consult-
ing Engineers of 1905 recognized that an objection
might be made from a military point of view to plac-
ing locks on the shore of a bay, exposed to guns of
hostile ships. We now understand that the con-
trolling reason for the change was a military one.
This change in the plans will result in an increase in
cost of the Canal by an amount judged from evidence
at our disposal to be not less than $10,000,000. We
are informed, however, that this change would greatly
lessen the cost of fortification.

*Increased Width of Canal*

Another change is the increase of the minimum
bottom width of the Canal from 200 feet to 300 feet.
This applies to a length of about 4.7 miles in the
Culebra Cut. We understand that this change will
increase the cost of the work by about $13,000,000.
The work upon the excavation of the Culebra Cut
under the revised plan has now so far advanced that
Appendix

this widening will not delay the completion of the Canal.

The widening will permit ships to pass one another in this portion of the Canal, as they may under the original plan in all other portions, and will otherwise facilitate navigation through it.

If slides occur after the completion of the Canal, the wider Canal is not as likely to be blocked as a narrow one.

We understand that this change was authorized directly by you on the presentation of its advantages by the Chief Engineer, and we merely call attention to it as one reason for the increased cost of the Canal.

*Increased Size of Locks*

Another change is the increase of the dimensions of the locks from 95 by 900 feet to 110 by 1000 feet. The increase in width we understand has been made in compliance with a request from the General Board of the Navy Department, in order to allow the passage of the largest war vessels contemplated.

A large increase in cost is involved in these enlarged dimensions.

*Changes in Breakwaters*

An important change is proposed in the location of the breakwater at the Atlantic end of the Canal. The plan provisionally adopted by the Board of Consulting Engineers of 1905, and adopted for the purpose of estimate by the minority of that board, was for a breakwater generally parallel with the channel, which included less than one third of Limon Bay; whereas the breakwater in the location now proposed
will protect the entire bay and furnish a more commodious harbor not only for ships using the Canal, but for all other shipping which makes use of the port. A considerable increase in cost is involved in this change.

We had an opportunity to view the present harbor during what is said to have been the only severe norther of the past two years, and have no doubt that a good breakwater is a desirable adjunct to the Canal. We are not prepared to pass on the precise location, form, or cost of this.

A change of less importance has been made at the Pacific end by relocating the dredged channel leading to deep water and increasing its width from 300 feet to 500 feet and by constructing a breakwater from the shore at La Boca to Naos Island with material excavated from the Culebra Cut. This breakwater, now under construction, serves to prevent currents across the Canal cut and tends to prevent deposits in the dredged channel and to increase the safety of navigation. The breakwater may also serve to carry a roadway to Naos Island. These changes involve some additional expense.

Relocation of Panama Railroad

The alignment of the Panama railroad has been materially changed south of Gatun. This change was made because it was found that the swamp near the Gatuncillo River would not support the very high railroad embankment required, if made with ordinary slopes, and a line crossing at a point higher up the river was selected, which does not, however, materially increase the length of the railroad. The con-
struction of the railroad will cost much more than was estimated by the minority of the Board of Consulting Engineers, who were unable to procure surveys of the proposed location. The recent change in location affords more ample and convenient anchorage immediately above the locks.

Other Changes

Some further changes or additions which have not yet been fully worked out have been mentioned to us as likely to be made as the work progresses, namely, the dredging out of a broad anchorage basin immediately downstream from the Gatun Locks, another for anchorage and room for turning of long ships near La Boca, and possibly another just below the Miraflores Locks. These can all be delayed until the completion of the main work of canal excavation and lock building, and then executed by the dredges that have done the main work. The work can thus be done without additional equipment, and at a low price per cubic yard.

Present Condition of Work

It has been suggested that we report upon the condition of the work and the progress being made, and, if found possible in the time at our disposal, upon the probable time of completion.

Organization

We have seen the work under way on all parts of the Canal. We have become acquainted with the engineers in responsible positions and have noted the organization and equipment.

It is our impression that the work is well organized and is being conducted energetically and well.
The work is done by day labor and not by the contract system.

The men are well paid, well housed, well fed, and well cared for in case of sickness or accident. Houses, furniture, fuel, water, drainage, and lights are furnished to employees without cost. Roads are built, schools supported, and Young Men's Christian Association buildings provided, which are practically club buildings. Parts of the running expenses are also paid. The premises are cleared and drained and the grass kept cut. The climate is especially adapted to outdoor life, and the ample porches, entirely enclosed by bronze-wire screens, give the greatest facility for this. We are especially pleased with the architectural arrangements of the houses. They are admirably adapted to the climatic conditions.

Bachelor quarters and hotels furnishing meals at moderate prices are also provided by the government.

Hospitals are provided, free medical attendance is furnished to employees, and medical attendance at low rates is supplied to families of employees.

A limited amount of free transportation, namely, one excursion trip each month to any station, is furnished on the Panama railroad to employees, and half rates are given in all other cases, and also half rates to families of employees. Free transportation in some cases, and in all other cases transportation at reduced rates to and from the Isthmus, is provided to employees and their families.

Six weeks' leave of absence each year, with full pay, is given to all monthly employees, and this includes not only office and engineering forces, but also the mechanical forces on the monthly basis.

The medical and sanitary department is especially
to be commended for its success in exterminating yellow fever and controlling malaria, and for other measures which have made the Isthmus a thoroughly healthful place in which to live.

The cost of the sanitary department, which represents the cost of keeping the Isthmus healthful, amounts to about $2,000,000 per year. This is a large sum, but the work is well done, and any decrease in the efficiency of the sanitary service might readily prove disastrous to the prosecution of the main work. We believe that in no other great construction work has so much been done for employees in the way of furnishing necessities, comforts, and luxuries of life at the cost of the work as has been done in this case. This is one reason for the high cost of the Canal.

Progress and Time of Completion

We have examined diagrams and statistics showing the amount of work accomplished by years and by months since the work was taken over by the United States, and showing the amounts of the various classes of work remaining to be done and the estimated rates of progress and times required for completion. It has been impossible for us to check these in detail, but we have compared them with other estimates, and with the work obviously done, and they seem reasonable to us. In the light of this showing, we see no reason why the Canal should not be completed, as estimated by the Chief Engineer, by January 1, 1915; in fact, it seems that a somewhat earlier completion is probable if all goes well, but in view of possible contingencies it is not prudent at this time to count on an earlier date.
Cost of Work

In examining the expenditures thus far made it must be borne in mind that large sums have been paid for steamships, dredges, steam shovels, locomotives, cars, tracks, shops, and all the equipment that is necessary to prosecute a work of this magnitude, and also that large sums have been spent for dwellings, offices, buildings of various kinds, for waterworks, sewers, paving, and other equipment, and that these expenditures have been made, in large measure, for the whole work, and that corresponding disbursements hereafter will be very much less in proportion than they have been to date.

Colonel Goethals has presented to us an estimate of the quantities of materials and the cost involved in the construction of the Canal as now planned, including all disbursements thus far made and the estimated amounts required for completion. These cover the greater width of excavation, the increased size of locks, the extra canal channel required by moving the Pacific Locks from La Boca to Miraflores, the improved harbor arrangements at Colon, and all other changes which have been adopted or which are now seriously contemplated. The payments to the New Panama Canal Company are included, and also the payments to the Republic of Panama and the cost of sanitation and Zone government, for which items the Board of Consulting Engineers of 1905 stated that it presented no estimates.

The estimates and allowances so made seem ample to us. In some items it would seem that considerable reductions could be made, but on the other hand, the work is large and novel and unforeseen contingencies
must be expected, so that it may be that the aggregate estimate as presented is not too large.

After deducting $15,000,000, representing the estimated receipts from the return of money loaned the Panama railroad, and from the collection of water rates to cover the cost of municipal improvements made in Panama and Colon, and from miscellaneous sources, this present estimate of the complete cost of the lock canal amounts to $360,000,000.

In making this estimate no reduction has been made for whatever salvage may be realized from the construction plant at the termination of the work, which plant has cost to date about $30,000,000.

The cost of the Canal as estimated in 1905 is frequently stated to be $140,000,000, but this is incorrect, as the minority report expressly excluded sanitation and Zone government, and the payments to Panama and the French company had already been made. Adding these amounts, using the present estimates of sanitation and Zone government, we have in round numbers the following:

Estimate of the minority of the Board of Consulting Engineers for the cost of construction, exclusive of sanitation and Zone government ................ $140,000,000
Payments made to the Republic of Panama and to the New Panama Canal Company ......................... 50,000,000
Sanitation and Zone government, as now estimated ......................... 27,000,000

Total ................................ $217,000,000

The difference between this cost and the total cost
The Conquest of the Isthmus

as now estimated is therefore $143,000,000. Of this amount nearly one half can be accounted for by the changes in the Canal and appurtenant works to which we have already referred, and the remainder is to be attributed mainly to the higher unit cost of the different items of the work, caused in part by the higher prices for plant, supplies, and labor which have prevailed in the United States since the estimate of 1905 was made, and which made it necessary to offer very high wages and special inducements in order to obtain the requisite force in a locality where the reputation for health was not good in the earlier years, in part to the adoption of an eight-hour day for most of the work instead of a ten-hour day, in part to the much greater expenditure for housing and care of employees and for auxiliary works than was anticipated, and in part, in our opinion, to the evident purpose to make the estimates ample and to provide liberally for contingencies.

When the work at Panama is completed, in addition to having the Canal, the United States will own the Panama railroad and the steamship line operated in connection therewith.

**Type of Canal**

In view of the fact that the cost of the lock canal, as now proposed, will largely overrun the estimate of the minority of the Board of Consulting Engineers of 1905, and that the excavation in the Culebra Cut is being made somewhat more rapidly than was anticipated, we have considered in a very general way the relative cost and time of construction of a sea-level canal.
Most of the factors which have operated to increase the cost of the lock canal would operate with similar effect to increase the cost of the sea-level canal, and at the present time there are additional factors of even greater importance to be considered as affecting the time of completion and cost of a sea-level canal. One of these is to be found in the Gamboa dam, proposed to be nearly 200 feet in height above its foundations, which would be about 60 feet below the normal river level. Prior to the construction of this dam a long and deep diversion channel must be provided of far greater magnitude than that for the Gatun Dam, which has been about two years in progress, and is not yet completed.

Judging by the time required for the construction of dams of similar magnitude in the United States, it is probable that were work on the Gamboa dam to be started as soon as possible this one feature of the sea-level project of the Board of Consulting Engineers of 1905 could not be completed until after the time required for the completion of the lock canal. The construction of this dam at Gamboa for the control of the Chagres is an essential preliminary to the excavation of the sea-level canal for the 13 miles from Bohio to Bas Obispo.

Furthermore, in addition to the Gamboa dam, the sea-level project provides for building for the control of tributary streams three large dams, the sites of which have not been examined.

Work is already far advanced on nearly all parts of the lock canal, and a change in the type would result in abandoning work done which represents large expenditure.

Under the plan now being carried out, the River
Chagres and each of the other rivers on the Isthmus tributary thereto is made an ally of the project. The waters of these rivers are handled economically and in such a way as to facilitate the operation of the Canal. With the sea-level project, these rivers instead of being allies would be enemies of the Canal, and floods in them would greatly interfere with the work.

The excavation of the Canal would be carried to 40 feet or more below sea-level and to a much greater depth below the bottoms of the valleys in which the upper streams now flow.

It would further be necessary to cut long and large diversion channels on each side of the Canal for streams entering the Chagres Valley. The cost of such lateral channels to protect the Culebra Cut alone from the comparatively small streams formerly entering it, including work done by the French, has probably been not less than $2,000,000. The channels required for the lower valley of the Chagres would be necessarily much longer, larger, and far more expensive.

ROCK EXCAVATION UNDER WATER

Much has been said about the economy of excavating rock under water by modern appliances as compared with the cost of such excavation in the dry with steam shovels after blasting.

We concur in the opinion of those in charge of work at the Isthmus that it is more economical, where the conditions are favorable, to excavate rock in the dry than by any under-water process now in use. Experience is not yet available to us which will justify the belief that, with the depth of cut and
the quality of rock found on the Isthmus, the general adoption of subaqueous methods would prove more expeditious or cheaper.

It is probable that more economical subaqueous methods will be sometime developed, but it would not be wise to base a change in plan of important work upon prospective results to be obtained by any method not yet thoroughly tried.

EARTHQUAKES

It has been suggested that the Canal region is liable to earthquake shocks and that a sea-level canal would be less subject to injury by earthquakes than a lock canal.

We have seen, in the city of Panama, the ruins of an old church, said to have been destroyed by fire, containing a long and extremely flat arch of great age, which convinces us that there has been no earthquake shock on the Isthmus during the one hundred and fifty years, more or less, that this structure has been in existence, that would have injured the work proposed.

Dams and locks are structures of great stability and little subject to damage by earthquake shocks. The successful resistance of the dams and reservoirs supplying San Francisco with water, even when those structures were located near the line of fault of the earthquake, gives confidence in the ability of well-designed masonry structures and earth embankments to resist earthquake shocks.

We do not regard such shocks as a source of serious damage to any type of canal at the Isthmus, but if they were so their effect upon the dams, locks, and
regulating works proposed for the sea-level canal would be much the same as upon similar structures of the lock canal. The Gamboa dam for controlling the floods of the Chagres in connection with the sea-level canal provides for a lake having an area of 29 square miles when full, and if this water were suddenly let loose into the sea-level canal it would seriously injure large portions thereof and wreck ships therein. A similar result would be reached if the other three dams of the sea-level canal retaining lakes, having an aggregate area of 10 square miles, were to be suddenly destroyed.

**WATER SUPPLY**

We believe that the sufficiency of the water supply for a lock canal has never been seriously questioned. It is true that during the dry season the natural flow of the streams would not be sufficient to furnish the water required for numerous lockages. There would even be times when the natural flow would not suffice to make good the loss by evaporation from the surface of the water in Gatun Lake. During the rainy season there is a great excess of water which can be readily stored in Gatun Lake with its area of 163 square miles. It is proposed to fill this lake during the rainy season 2 feet above its normal level, and to draw it as needed during the dry season. It is computed that by drawing it 5 feet below normal level, which draft would leave 40 feet of water through Culebra Cut, the supply in a dry year would be sufficient to serve from 30 to 40 lockages up and an equal number of lockages down daily. Each lockage might consist of a single large vessel, or a fleet of
smaller vessels capable of being in the lock at one
time, as is common at Sault Ste. Marie. For compari-
on the published record shows that an average of only
12 ships per day passed through the Suez Canal
in 1907.

Ultimately, if needed for increased traffic, additional
water may be held from wet seasons and made
available in dry ones. This may be accomplished
either by raising further the high-water level in
Gatun Lake or by lowering the low-water level in the
lake, this lowering being accompanied, if necessary,
by the deepening of the Canal, or storage may be
provided by an entirely independent reservoir, for
which there are excellent sites.

From our examinations in the neighborhood of
Gatun Dam, we can find no reason to apprehend
important loss of water by seepage through the
ridges surrounding the lake, while in our judgment
the bed of the lake will be practically impervious to
water.

The water supply in sight is so much greater than
any need that can be reasonably anticipated that the
best method of securing more water when the time
of need arrives does not require to be considered now.

CONCLUSIONS

Your board is satisfied that the dams and locks, the
lock gates, and all other engineering structures in-
volved in the lock-canal project are feasible and safe,
and that they can be depended upon to perform with
certainty their respective functions.

We do not find any occasion for changing the type
of canal that has been adopted.
A change to a sea-level plan at the present time would add greatly to the cost and time of construction, without compensating advantages, either in capacity of canal or safety of navigation, and hence would be a public misfortune.

We do find in the detailed designs that have been adopted, or that are under consideration, some matters where other arrangements than those now considered seem worthy of study. As these proposed changes are of a tentative nature and do not in any case affect the main questions herein discussed, they are not taken up in this report.

Very respectfully,

Frederic P. Stearns,          James D. Schuyler,
Arthur P. Davis,              Isham Randolph,
Henry A. Allen,               John R. Freeman,
                             Allen Hazen.

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