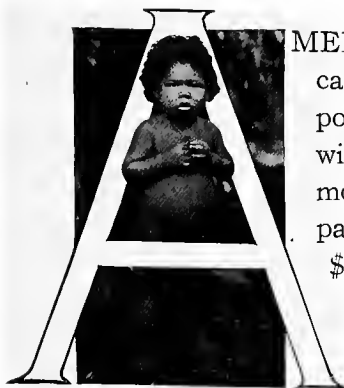


CHAPTER VIII

THE FORMATIVE PERIOD



AMERICAN control of the canal, as I have already pointed out, was taken over without any particular ceremony immediately after the payment to Panama of the \$10,000,000 provided for in the treaty. Indeed so slight was the friction incident to the transfer of ownership from the

a certain and resistless progress toward the goal.

In accordance with the Spooner act President Roosevelt on March 8, 1904, appointed the first Isthmian Canal Commission with the following personnel:

Admiral John G. Walker, U. S. N., *Chairman*,
Major General George W. Davis, U. S. A.,
William Barclay Parsons,
William H. Burr,
Benjamin M. Harrod,
Carl Ewald Gunsky,
Frank J. Hecker.

In 1913 when the canal approached completion not one of these gentlemen was associated with it. Death had carried away Admiral Walker, but official mortality had ended the canal-digging careers of the

French to the Americans that several hundred laborers employed on the Culebra Cut went on with their work serenely unconscious of any change in management. But though work was uninterrupted the organization of the directing force took time and thought. It took more than that. It demanded the testing out of men in high place and the rejection of the unfit; patient experimenting with methods and the abandonment of those that failed to produce results. There was a long period of this experimental work which sorely tried the patience of the American people before the canal-digging organization fell into its stride and moved on with



Photo by Underwood & Underwood

TUNNEL FOR THE OBISPO DIVERSION CANAL

others. Indeed under the rule of President Roosevelt the tenure of office of Isthmian Commissioners was exceedingly slender and the whole commission as originally designed was finally abolished being replaced by one made up, with one exception, of officers of the army and navy. The first commission visited the Isthmus, stayed precisely 24 days, ordered some new surveys and returned to the United States. The most important fact about its visit was that it

was accompanied to the scene of work by an army surgeon, one Dr. W. C. Gorgas, who had been engaged in cleaning up Havana. Major Gorgas, to give him his army title, was not at this time a member of the Commission but had been appointed Chief Sanitary Officer. I shall have much to say of his work in a later chapter; as for that matter Fame will have much to say of him in later ages. Col. Goethals, who will share that pinnacle was not at this time associated with the canal work. Coincidentally with the Commission's visit the President appointed as chief engineer, John F. Wallace, at the moment general manager of the Illinois Central

1905, to April 1, 1907, and Col. George W. Goethals from April 1, 1907, to the time of publication of this book and doubtless for a very considerable period thereafter. Each of these officials encountered new problems, serious obstacles, heartbreaking delays and disappointments. Two broke down under the strain; doubtless the one who took up the work last profited by both the errors and the successes of his predecessors.

It is but human nature to give the highest applause to him who is in at the death, to immortalize the soldier who plants the flag on the citadel, forgetting him who fell making a breach in the outer breastworks and thereby made possible the ultimate triumph.

Wallace at the very outset had to overcome one grim and unrelenting enemy which was largely subdued before his successors took up the work. Yellow fever and malaria ravaged the Isthmus, as they had done from time immemorial, and although Sanitary Officer Gorgas was there with knowledge of how to put that foe to rout the campaign was yet to be begun. They say that Wallace had a

lurking dread that before he could finish the canal the canal would finish him, and indeed he had sound reasons for that fear. He found the headquarters of the chief engineer in the building on Avenida Centrale now occupied by the United States legation, but prior to his time tenanted by the French Director-General. The streets of the town were unpaved, ankle deep in foul mire in the rainy season, and covered with germ-laden dust when dry. There



Photo by Underwood & Underwood

THE TWO COLONELS

W. C. Gorgas and George W. Goethals, whose combined work gave the canal to the world

of the Illinois Central Railroad. His salary was fixed at \$25,000 a year.

In telling the story of the digging of the Panama Canal we shall find throughout that the engineer outshines the Commission; the executive rather than the legislative is the ruling force. The story therefore groups itself into three chapters of very unequal length—namely the administrations as chief engineers of John F. Wallace, from June 1, 1904, to June 28, 1905; John F. Stevens, June 30,



A WALK AT ANCON

being no sewers the townsfolk with airy indifference to public health emptied their slops from the second-story windows feeling they had made sufficient concession to the general welfare if they warned passersby before tilting the bucket. Yellow fever was always present in isolated cases, and by the time Wallace had been on the job a few months it became epidemic, and among the victims was the wife of his secretary.

However, the new chief engineer tackled the job with energy. There was quite enough to enlist his best energies. It must be remembered that at this date the fundamental problem of a sea level *vs.* a lock canal had not been determined—was not definitely settled indeed until 1906. Accordingly Engineer Wallace's first work was getting ready to work. He found 746 men tickling the surface of Culebra Cut with hand tools; the old French houses, all there were for the new force had been seized upon by natives or overrun by the jungle; while the French had left great quantities

of serviceable machinery it had been abandoned in the open and required careful overhauling before being fit for use; the railroad was inadequate in track mileage and in equipment. Above all the labor problem was yet to be successfully solved. In his one year's service Wallace repaired 357 French houses and built 48 new ones, but the task of housing the employees was still far from completed. Men swarmed over the old French machinery, cutting away the jungle, dousing the metal with kerosene and cleaning off the rust.

Floating dredges were set to work in the channel at the Atlantic end—which incidentally has been abandoned in the completed plans for the canal though it was used in preliminary construction. The railroad was reëquipped and extended and the foundation laid for the thoroughly up-to-date road it now is. Meanwhile the surveying parties were busy in the field collecting the data from which after a prolonged period of discussion, the vexed question of the type of canal should be determined.



IN THE HOSPITAL GROUNDS

Two factors in the situation made Wallace's job the hardest. The Commission made its headquarters in Washington, 2000 miles or a week's journey away from the job, and the American people, eager for action, were making the air resound with cries of "make the dirt fly!" In a sense Wallace's position was not unlike that of Gen. McClellan in the opening months of the Civil War when the slogan of the northern press was "On to Richmond," and no thought was given to the obstacles in the path, or the wisdom of preparing fully for the campaign before it was begun. There are many who hold today that if Wallace had been deaf to those who wanted to see the dirt fly, had taken the men off the work of excavation until the type of canal had been determined and all necessary housing and sanitation work had been completed, the results attained would have been better, and the strain which broke down this really capable engineer would have been averted.

Red tape immeasurable wound about the Chief Engineer and all his assistants. Requisitions had to go to the Commission for approval and the Commission clung to Washington tenaciously, as all federal commissions do wherever the work they are commissioned to perform may be situated. During the Civil War days a story was current of a Major being examined for promotion to a colonelcy.

"Now, Major," asked an examiner, "we will con-

sider, if you please, the case of a regiment just ordered into battle. What is the usual position of the colonel in such a case?"

"On Pennsylvania Avenue, about Willard's Hotel," responded the Major bravely and truthfully.

The officers who directed Wallace's fighting force clung to Pennsylvania Avenue and its asphalt rather than abide with Avenida Centrale and its mud. So too did succeeding commissions until Theodore Roosevelt, who had a personal penchant for being on the firing line, ordered that all members of the Commission should reside on the Isthmus. At that he had trouble enforcing the order except with the Army and Navy officers who made up five-sevenths of the Commission.

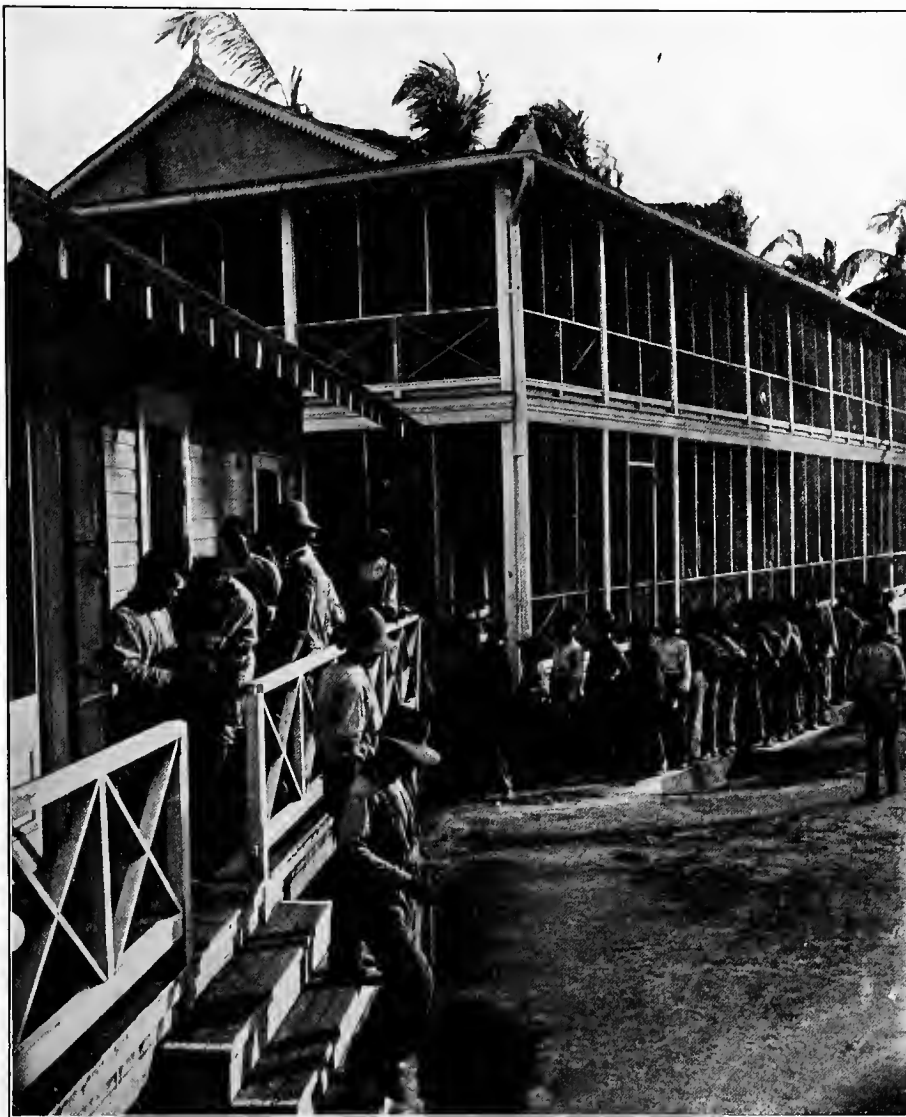
How great was the delay caused by red tape and absentee authorities cannot be estimated. When requisitions for supplies reached Washington the regulations required that bids be advertised for. I rather discredit the current story that when a young Panamanian arrived at Ancon Hospital and the mother proved unable to furnish him with food, the doctor in charge was officially notified that if he bought a nursing bottle without advertising thirty days for bids he must do so at his own expense. That story seems too strikingly illustrative of red-tape to be true. But it is true that after Col.



Photo by Underwood & Underwood

FRENCH COTTAGES ON THE WATER FRONT, CRISTOBAL

Gorgas had worked out his plans for furnishing running water to Panama, and doing away with the cisterns and great jars in which the residents stored water and bred mosquitoes, it took nine months to get the iron pipes, ordinary ones at that, to Panama. Meanwhile street paving and sewerage were held up and when Wallace wired the Commission to hurry he was told to be less extravagant in his use of the cable.



PAY DAY FOR THE BLACK LABOR

No man suffered more from this sort of official delay and stupidity than did Col. Gorgas. If any man was fighting for life it was he—not for his own life but that of the thousands who were working, or yet to work on the canal. Yet when he called for wire netting to screen out the malarial mosquitos he was rebuked by the Commission as if he were asking it merely to contribute to the luxury of the employees. The amount of ingenuity expended by the Commission in suggesting ways in which wire netting might be saved would be admirable as indicative of a desire to guard the public purse, except for the fact that in saving netting they were wasting human lives. The same policy was pursued when appeals came in for additional equipment for the hospitals, for new machinery, for wider authority. When-

ever anything was to be done on the canal line the first word from Washington was always criticism—the policy instantly applied was delay.

Allowing for the disadvantages under which he labored Mr. Wallace achieved great results in his year of service on the Isthmus. But his connection with the canal was ended in a way about which must ever hang some element of mystery. He complained bitterly, persistently and

justly about the conditions in which he was compelled to work and found in President Roosevelt a sympathetic and a reasonable auditor. Indeed, moved by the Chief Engineer's appeals, the President endeavored to secure from Congress authority to substitute a Commission of three for the unwieldy body of seven with which Wallace found it so hard to make headway. Failing in this the President characteristically enough did by indirection what Congress would not permit him to do directly. He demanded and received the resignations of all the original commissioners, and appointed a new board with the following members:

Theodore P. Shonts, *Chairman*,
 Charles E. Magoon, *Governor of the Canal Zone*,
 John F. Wallace, *Chief Engineer*,

Mordecai T. Endicott,
 Peter C. Hains,
 Oswald H. Ernst,
 Benjamin M. Harrod.

As in the case of the earlier commissioners none of these remained to see the work to a conclusion.

This commission, though similar in form, was vastly different in fact from its predecessor. The President in appointing it had directed that its first three members should constitute an executive committee, and that two of these, Gov. Magoon and Engineer Wallace, should reside continuously on the Zone. To further concentrate power in Mr. Wallace's hands he was made Vice-President of the Panama Railroad. The President thus secured practically all he had asked of Congress, for the executive committee of three was as powerful as the smaller commission which Congress had refused him. In all this organization Mr. Wallace had been consulted at every step. He stayed for two months in Washington while the changes were in progress and expressed his entire approval of them. It was therefore with the utmost amazement that the President received from him, shortly after his return to the Isthmus, a cable requesting a new conference and hinting at his resignation.

At the moment that cable message was sent Panama was shuddering in the grasp of the last yellow fever epidemic that has devastated that territory. Perhaps had Col. Gorgas secured his wire netting earlier, or Wallace's appeals for water pipes

met with prompter attention it might have been averted. But in that May and June of 1905 the fever ravaged the town and the work camps almost as it had in the days of the French. There had been, as already noted, some scattered cases of yellow fever in the Zone when the Americans took hold, but they were too few and too widely separated to cause any general panic. The sanitary authorities however noted with apprehension that they did not decrease, and that a very considerable proportion were fatal. It was about this time that the Commission was snubbing Col. Gorgas because of his insatiable demands for wire screening. In April there were seven cases among the employees in the Commission's headquarters in Panama. Three died and among the 300 other men employed there panic spread rapidly. Nobody cared about jobs any longer. From all parts of the Zone white-faced men flocked to the steamship offices to secure passage home. Stories about the ravages of the disease among the French became current, and the men at work shuddered as they passed the little French cemeteries so plentifully scattered along the Zone.

The sanitary forces wheeled out into the open and went into the fight. Every house in Panama and Colon was fumigated, against the bitter protests of many of the householders who would rather face yellow fever than the cleansing process, and who did not believe much in these scientific ideas of the "gringoes" anyway. An army of inspectors made house to house canvasses of the towns and removed, sometimes by force, all suspected victims to the iso-



Photo by Underwood & Unserwood

IN WALLACE'S TIME
 Sanitation work in Panama City

The sanitary forces wheeled out into the open and went into the fight. Every house in Panama and Colon was fumigated, against the bitter protests of many of the householders who would rather face yellow fever than the cleansing process, and who did not believe much in these scientific ideas of the "gringoes" anyway. An army of inspectors made house to house canvasses of the towns and removed, sometimes by force, all suspected victims to the iso-

lation hospitals. The malignant mosquitoes, couriers of the infection, were pursued patiently by regiments of men who slew all that were detected and deluged the breeding places with larvacide. The war of science upon sickness soon began to tell. June showed the high-water mark of pestilence with sixty-two cases, and six deaths. From that point it declined until in December the last case was

reaching New York he met the then Secretary of War, afterwards President, William Howard Taft, to whom he expressed dissatisfaction with the situation and asked to be relieved at the earliest possible moment. Secretary Taft declined to consider his further association with the canal, for a moment, demanded that his resignation take effect at once and reproached him for abandoning the work in words



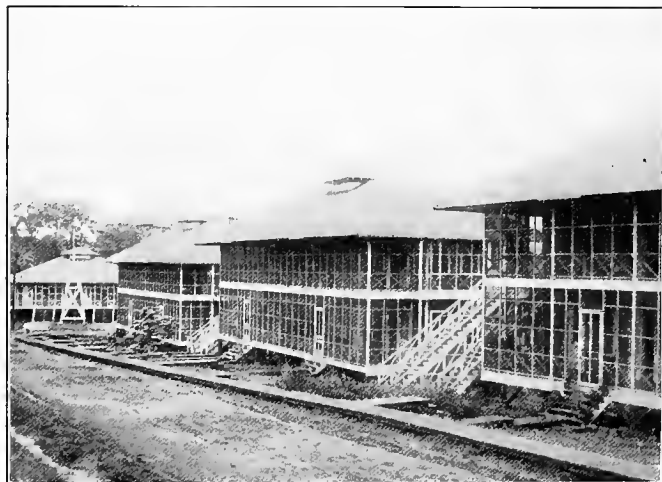
THE FUMIGATION BRIGADE

When the members of this command finished with a district in Panama the mosquito was done for

registered. Since then there has been no case of yellow fever originating on the Isthmus, and the few that have been brought there have been so segregated that no infection has resulted.

It was, however, when the epidemic was at its height that Mr. Wallace returned from Washington to the Isthmus. Almost immediately he cabled asking to be recalled and the President, with a premonition of impending trouble, so directed. On

that stung, and which when reiterated in a letter and published the next day put the retiring engineer in a most unenviable position. From this position he never extricated himself. Perhaps the fear of the fever, of which he thought he himself had a slight attack, shook his nerve. Perhaps, as the uncharitable thought and the Secretary flatly charged, a better position had offered itself just as he had become morally bound to finish the canal work. Or



TYPICAL SCREENED HOUSES

perhaps he concluded in the time he had for cool reflection on the voyage to Panama that the remedies offered for the red tape, divided authority and delay that had so handicapped him were inadequate. His communication to the press at the time was unconvincing. The fairest course to pursue in the matter is to accept Mr. Wallace's own statement made to a congressional investigating committee nearly a year later, in answer to a question as to the cause of his resignation:

"My reason was, that I was made jointly responsible with Mr. Shonts and Mr. Magoon for work on the canal, while Mr. Shonts had a verbal agreement with the President that he should have a free rein in the management of all matters. I felt Mr. Shonts was not as well qualified as I was either as a business man or an administrator, and he was not an engineer. . . . I thought it better to sacrifice my ambitions regarding this work, which was to be the crowning event of my life, than remain to be humiliated, forced to disobey orders, or create friction."

The Wallace resignation was at the moment most unfortunate. There had for months been an almost concerted effort on the part

of a large and influential section of the press, and of men having the public ear to decry the methods adopted at Panama, to criticize the men engaged in the work and to magnify the obstacles to be overcome. Perhaps this chorus of detraction was stimulated in part by advocates of the Nicaragua route hoping to reopen that controversy. Probably the transcontinental railroads, wanting no canal at all, had a great deal to do with it. At any rate it was loud and insistent and the men on the Isthmus were seriously affected by it. They knew by Mr. Wallace's long absence that some trouble was brewing in Washington. His sudden departure again after his return from the capital and the rumor that he had determined to take a more profitable place added to the unrest. Probably the rather severe letter of dismissal with which Secretary Taft met the Chief Engineer's letter of resignation, and the instantaneous appointment in his place of John F. Stevens, long associated with James J. Hill in railroad building, at a salary \$5000 a year greater, was the best tonic for the tired feeling of those on the Isthmus. It indicated that the President thought those who had accepted positions of command on the Canal Zone had enlisted for the war, and that they could not desert in the face of the enemy without a proper rebuke. It showed furthermore that the loss of one man would not be permitted to demoralize the service, but that the cry familiar on the line of battle "Close up! Close up,



A STREET AFTER PAVING

Before paving it was of the sort shown on page 39

men! Forward"! was to be the rallying cry in the attack on the hills of Panama.

Despite the unfortunate circumstances attending Mr. Wallace's retirement, his work had been good, so far as it went. In office a little more than a year he had spent more than three months of the time in Washington or at sea. But he had made more than a beginning in systematizing the work, in repairing the railroad, in renovating the old machinery and actually making "the dirt fly". Of that objectionable substance—on the line of the canal, if anywhere, they applaud the definition "dirt is matter out of place"—he had excavated 744,644 yards. Not much of a showing judged by the records of 1913, but excellent for the machinery available in 1905. The first steam shovel was installed during his régime and before he left nine were working. The surveys, under his direction,



HOSPITAL BUILDINGS, UNITED FRUIT CO.

were of great advantage to his successor who never failed to acknowledge their merit.

Mr. Stevens, who reached the canal, adopted at the outset the wise determination to reduce construction work

to the minimum and concentrate effort on completing arrangements for housing and feeding the army of workers which might be expected as soon as the





Photo by Underwood & Underwood

BEGINNING THE NEW DOCKS, CRISTOBAL

Commissary and Subsistence Department, and the development of the railroad. The inducement of free quarters added to high wages to attract workers also originated with him. At the same time Gov. Magoon was working over the details of civil administration, the schools, courts, police system and road building. The really fundamental work of canal building, the preparation of the ground for the edifice yet to be erected, made great forward strides at this period. But the actual record of excavation was but small.

One reason for this was the hesitation over the type of canal to be adopted. It is obvious that several hundred thousand cubic yards of dirt dug out of a ditch have to be dumped somewhere. If deposited at one place the dump would be in the way of a sea-level canal while advantageous for the lock type. At another spot this condition would be reversed. Already the Americans had been compelled to move a second time a lot of spoil which the French had excavated, and which, under the American plans, was in danger of falling back into Culebra Cut. "As a gift of prophecy is withheld from us in these latter days," wrote Stevens plaintively in reference to the vacillation concerning the plans, "all we can do now is to make such arrangements as may look proper as far ahead as we can see."

President Roosevelt meanwhile was doing all he could to hasten determination of the problem.

Just before the appointment of Mr. Stevens he appointed an International Board of Advisory Engineers, five being foreign and nine American, to examine into the subject and make recommendations. They had before them a multiplicity of estimates upon which to base their recommendations and it may be noted eight years after the event that not one of the estimates came within one hundred million dollars of the actual cost. From which it appears that when a nation undertakes a great public work it encounters the same financial disillusionments that come to the young homebuilder when he sets out to build him a house from architect's plans guaranteed to keep the cost within a fixed amount.

Poor De Lesseps estimated the cost of a sea-level canal at \$131,000,000, though it is fair to say for the French engineers whose work is so generally applauded by our own that their estimate was several million dollars higher. The famous International Congress had estimated the cost of a sea-level canal at \$240,000,000. In fact the French spent \$260,000,000 and excavated about 80,000,000 cubic yards of earth! Then came on our estimators. The Spooner act airily authorized \$135,000,000 for a canal of any type, and is still in force though we have already spent twice that amount. The Walker Commission fixed the cost of a sea-level canal with a dam at Alhajuela and a tide lock at Miraflores at \$240,000,000. The majority of President Roose-



Photo by Underwood & Underwood

A BACK STREET IN COLON

This street is as clean and well paved as any in the United States

velt's Board of Advisory Engineers reported in favor of a sea-level canal and estimated its cost at \$250,000,000; the minority declared for a lock canal fixing its cost "in round numbers" at \$140,000,000. Engineer Wallace put the cost of a sea-level canal at \$300,000,000 exclusive of the \$50,000,000 paid for the Canal Zone. Col. Goethals came in in 1908, with the advantage of some years of actual construction, and fixed the cost of the sea-level canal at \$563,000,000 and the lock type at \$375,000,000. He guesses best who guesses last, but it may be suggested in the vernacular of the streets that even Col. Goethals "had another guess coming".

On all these estimates the most illuminating comment is furnished by the Official Handbook of the Panama Canal for 1913 showing total expenditures to November 1, 1912, of \$270,625,624 exclusive of fortification expenditures. The Congressional ap-

propriations to the same date, all of which were probably utilized by midsummer of 1913, were \$322,551,448.76.

The action of his Advisory Board put President Roosevelt for the moment in an embarrassing position. A swinging majority declared for a sea-level canal, and even when the influence of Engineer Stevens, who was not a member of the Board, was exerted for the lock type it left the advocates of that form of canal still in the minority. To ask a body of eminent scientists to advise one and then have them advise against one's own convictions creates a perplexing situation. But Roosevelt was not one to allow considerations of this sort to weigh much with him when he had determined a matter in his own mind. Accordingly he threw his influence for the lock type, sent a resounding message to Congress and had the satisfaction of seeing his views approved



the Panama railroad as the original bed would be covered by the new lake. The development of the commissary system which supplied every thing needful for the daily life of the employee,



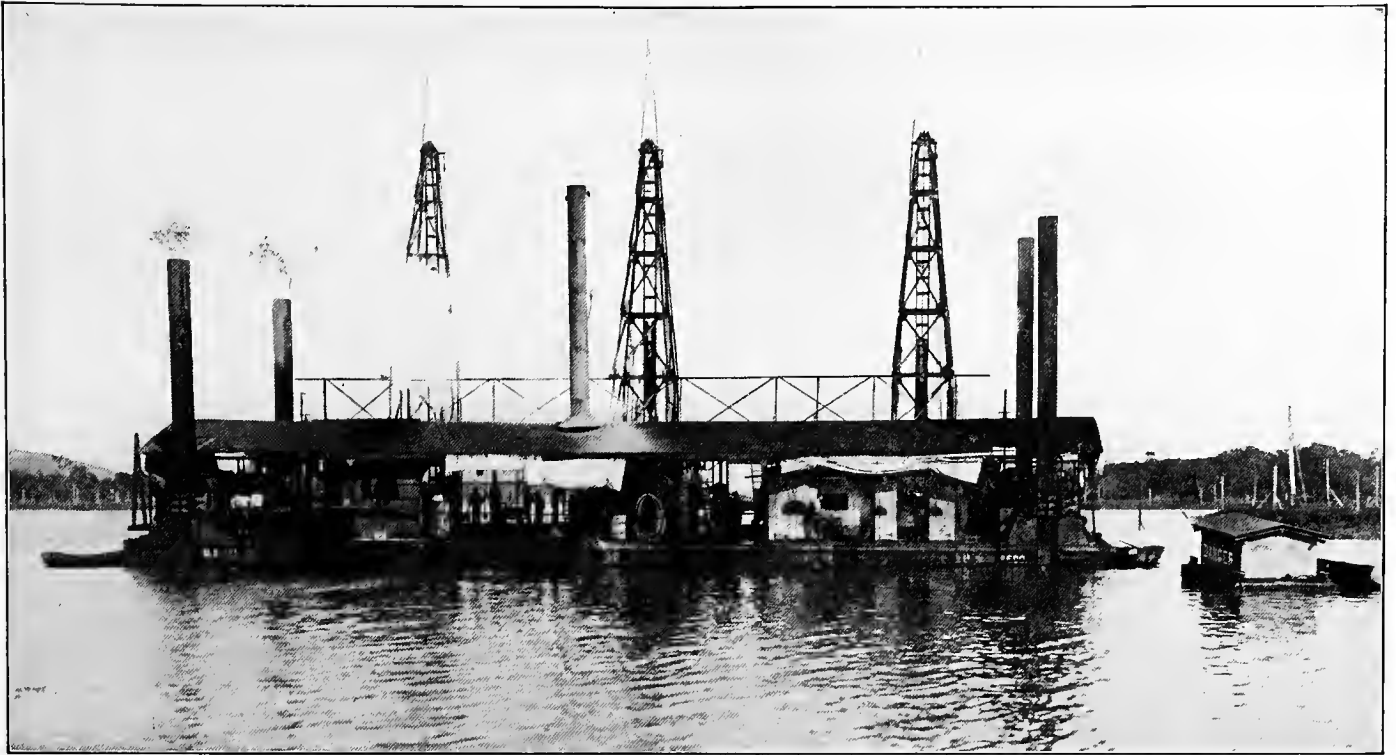


Photo by Underwood & Underwood

A DRILL BARGE AT WORK

The sea and tidal waters are underlaid with coral rock necessitating much submarine blasting

they were right. There is something about working for the nation that stirs a man's loyalty as mere private employment never can. But in this instance Mr. Shonts was in Washington, convenient to the ear of the President while Mr. Stevens was on the Zone. Accordingly the President approved of the Chairman's plan, and directed the Secretary of War, Mr. Taft, to advertise for bids. Mr. Stevens was discontented and showed it. That his judgment would be justified in the end he could not know. That it had been set aside for the moment he was keenly aware, and that he was being harassed by Congress and by innumerable rules such as no veteran railroad builder had ever been subjected to did not add to his comfort.

His complaints to the Secretary of War were many, and not of a sort to contribute to that official's peace of mind. When the bids came in from the would-be contractors they were all rejected on the ground that they did not conform to the specifications, but the real reason was that the President at heart did not believe in that method of doing the work, and was sure that the country agreed with him. This should have allayed Mr. Stevens' rising

discontent. It certainly offended Chairman Shonts, who stood for the contract system, and when the bids were rejected and that system set aside promptly resigned. The President thereupon consolidated the offices of Chairman of the Commission and Chief Engineer in one, Mr. Stevens being appointed that one. Given thus practically unlimited power Mr. Stevens might have been expected to be profoundly contented with the situation. Instead he too resigned on the first of April, 1907.

About his resignation as about that of Mr. Wallace there has always been a certain amount of mystery. He himself made no explanation of his act, though his friends conjectured that he was not wholly in harmony with the President's plan to abolish the civilian commission altogether, and fill its posts by appointments from the Army and Navy. On the Isthmus there is a story that he did not intend to resign at all. Albert Edwards, who heard the story early, tells it thus:

"One of the canal employees, who was on very friendly terms with Stevens, came into his office and found him in the best of spirits. When the business in hand was completed he said jovially:



Photo by S. H. Elliott

PACIFIC ENTRANCE TO THE CANAL

“Read this. I’ve just been easing my mind to T. R. It’s a hot one—isn’t it?” And he handed over the carbon copy of his letter. His visitor read it with great seriousness.

“Mr. Stevens’, he said, ‘that is the same as a resignation’.

“And Stevens laughed.

“Why, I’ve said that kind of thing to the Colonel a dozen times. He knows I don’t mean to quit this job’.

“But about three hours after the letter reached Washington Mr. Stevens received a cablegram: ‘Your resignation accepted’”.

At any rate the Stevens resignation called forth no such explosive retort as had been directed against the unhappy Wallace, and he showed no later signs of irritation, but came to the defense of his successor in a letter strongly approving the construction of certain locks and dams which were for the moment the targets of general public criticism.

Two weeks before Stevens resigned the other members of the Commission, excepting Col. Gorgas, in response to a hint from the President had sent in their resignations. Mr. Roosevelt had determined that henceforward the work should be done by army and navy officers, trained to go where the work was to be done and to stay there until recalled; men who had entered the service of the nation for

life and were not looking about constantly to “better their conditions”. He had determined further that the government should be the sole contractor, the only employer, the exclusive paymaster, landlord and purveyor of all that was needful on the Zone. In short he had planned for the Canal Zone a form of administration which came to be called socialistic and gave cold chills to those who stand in dread of that doctrine. To carry out these purposes he appointed on April 1, 1907, the following commission:

Lieut.-Col. George W. Goethals, *Chairman and Chief Engineer*,

Major D. D. Gaillard, U. S. A.,

Major William L. Sibert, U. S. A.,

Mr. H. H. Rousseau, U. S. N.,

Col. W. C. Gorgas, U. S. A., Medical Corps,

Mr. J. C. S. Blackburn,

Mr. Jackson Smith,

Mr. Joseph Bucklin Bishop, *Secretary*.

A majority of this commission was in office at the time of publication of this book, and gave evidences of sticking to the job until its completion. Senator Blackburn resigned in 1910 and was succeeded by Hon. Maurice H. Thatcher, also of Kentucky; and Mr. Smith retired in favor of Lieut. Col. Hodges in 1908.* With the creation of this commission began the forceful and conclusive administration of Col. Goethals, the man who finished the canal.

*In June, 1913, President Wilson announced the pending appointment of Richard L. Metcalfe of Nebraska to succeed Commissioner Thatcher, but at the time of the publication of this book the appointment had not been consummated.

CHAPTER IX

COL. GOETHALS AT THE THROTTLE



HE visitor to the Canal Zone about 1913 could hardly spend a day in that bustling community without becoming aware of some mighty potentate not at all mysterious, but omnipresent and seemingly omniscient, to whom all matters at issue were referred, to whom nothing was secret,

whose word was law and without whose countenance the mere presence of a visitor on the Zone was impossible. The phrases most in use were "see the Colonel," "ask the Colonel" and "the Colonel says". If there had been a well-conducted newspaper on the Zone these phrases would have been cast in slugs in its composing room for repeated and ready use. No President of the United States, not even Lincoln in war times, exerted the authority he daily employed in the zenith of his power. The aggrieved wife appealed to his offices for the correction of her marital woes, and the corporation with a \$600,000 steam crane to sell talked over its characteristics with the Colonel.

He could turn from a vexed question of adjusting the work of the steam shovels to a new slide in the Culebra Cut, to compose the differences of rival dancing clubs over dates at the Tivoli Hotel ballroom. On all controverted questions there was but one court of last resort. As an Isthmian poetaster put it:

"See Colonel Goethals, tell Colonel Goethals,
It's the only right and proper thing to do.
Just write a letter, or even better
Arrange a little Sunday interview".

Engineer Stevens in a speech made at the moment of his retirement before a local club of workers said:

"You don't need me any longer. All you have to do now is to dig a ditch. What you want is a statesman".

A statesman was found and his finding exemplifies strikingly the fact that when a great need arises the man to meet it is always at hand, though frequently in obscurity. Major George W. Goethals of the General Staff, stationed at Washington was far from being in the public eye. Anyone who knows his Washington well knows that the General Staff is a sort of general punching bag for officers of the Army who cannot get appointments to it, and for newspaper correspondents who



Photo by Underwood & Underwood

COL. GOETHALS AT HIS DESK

are fond of describing its members as fusty bureaucrats given to lolling in the Army and Navy Club while the Army sinks to the level of a mere ill-ordered militia. But even in this position Major Goethals had not attained sufficient eminence to have been made a target for the slings and arrows of journalistic criticism. As a member of the Board of Fortifications, however, he had attracted the attention of Secretary Taft, and through him had been brought into personal relations with President Roosevelt.

Of course when a man has "made good" everybody is quick to discern in him the qualities which compel success. But Roosevelt must have been able to discover them in the still untested Goethals, for when the Stevens resignation reached Washington the President at once turned to him with the remark, "I've tried two civilians in the Canal and they've both quit. We can't build the canal with a new chief engineer every year. Now I'm going to give it to the Army and to somebody who can't quit."

John F. Stevens resigned April 1, 1907, and on the

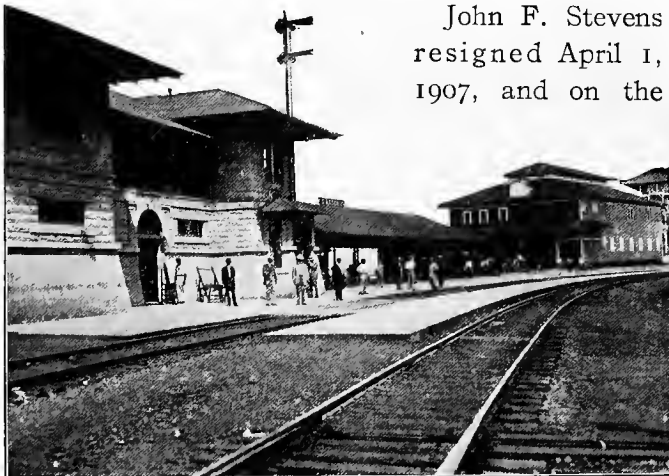


Photo by Underwood & Underwood

RAILWAY STATION AT GATUN

The Panama Railroad is being equipped with stations and rolling stock of the first-class



PRESIDENT TAFT ARRIVES

same day Col. Goethals became Chief Engineer of the Panama Canal, and the supreme arbiter of the destinies of all men and things on the Canal Zone. Everybody with a literary turn of mind who goes down there describes him as the Benevolent Despot, and that crabbed old philosopher Thomas Carlyle would be vastly interested could he but see how the benevolent despotism which he described as ideal but impossible is working successfully down in the semi-civilized tropics.

Before describing in detail Col. Goethals' great work, the digging of the canal, let me relate some incidents which show what manner of man it was that took the reins when the Americans on the ditch swung into their winning stride.

This is the way they tell one story on the Isthmus:

A somewhat fussy and painfully perturbed man bustled into the office of Col. Goethals one morning and plunged into his tale of woe.

"Now I got that letter of yours, Colonel", he began but stopped there checked by a cold gaze from those quiet blue eyes.

"I beg your pardon", said the Colonel suavely, "but you must be mistaken. I have written you no letter".

"Oh, yes, Colonel, it was about that work down at Miraflores".

"Oh, I see. You spoke a little inaccurately. You

meant you received my orders, not a letter. You have the orders, so that matter is settled. Was there anything else you wished to talk with me about”?

But the visitor's topic of conversation had been summarily exhausted and, somewhat abashed, he faded away.

And again: A high official of the Isthmian Commission had been somewhat abruptly translated from the Washington office to Ancon. There was no

He spoke of his fears to the Colonel at lunch one day.

“Let's walk over to the site and see”, remarked that gentleman calmly. It may be noted in passing that walking over and seeing is one of the Colonel's favorite stunts. There are mighty few, if any, points on the Canal Zone which he has not walked over and seen, with the result that his knowledge of the progress of the work is not only precise but personal. But to return to the house a-building.



COL. GOETHALS REVIEWING THE MARINES AT CAMP ELLIOTT

house suitable for his occupancy and the Colonel ordered one built to be ready, let us say; October first. Meanwhile the prospective tenant and his family abode at the Tivoli Hotel which, even to one enjoying the reduced rates granted to employees, is no inexpensive spot. Along about the middle of August he began to get apprehensive. A few foundation pillars were all that was to be seen of the twelve-room house, of the type allotted to members of the Commission, which was to be his.

On arrival there three or four workmen were found plugging away in a leisurely manner under the eye of a foreman to whom the Colonel straightway addressed himself, “You understand the orders relative to this job”? he said to the foreman, tentatively.

“Oh, yes, Colonel”, responded that functionary cheerfully, “it is ordered for October first, and we are going to do our very best”.

“Pardon me”, blandly but with a suspicion of

satire, "I was afraid you did not understand the order and I see I was right. Your order is to have this house ready for occupancy October first. There isn't anything said about doing your best. The house is to be finished at the time fixed".

Turning, the Colonel walked away, giving no heed to the effort of the foreman to reopen the conversation. Next day that individual called on the prospective tenant.

"Say", he began ingratiatingly, "you don't really need to be in that house October first, do you? Would a few days more or less make any difference to you"?

"Not a bit".

"Well, then", cheering up, "won't you just tell the Colonel a little delay won't bother you"?

"Not I! I want to stay on this Isthmus. If

you want to try to get the Colonel's orders changed you do it. But none of that for me".

And the day before the time fixed the house was turned over complete.

It is fair to say however that peremptory as is Col. Goethals in his orders, and implacable in his insistence on literal obedience, he



PRESIDENT TAFT AND "THE COLONEL"

yields to the orders of those who rank him precisely what he exacts from those whom he commands. The following dialogue from a hearing before the House Committee on Appropriations will illustrate my point. The subject matter was the new Washington Hotel at Colon.

"*The Chairman:* Did you ever inquire into the right of the Panama Railroad Company, under the laws of the State of New York, to go into the hotel business?"

"*Col. Goethals:* No sir; I got an order from the President of the United States to build that hotel and I built it".

This military habit of absolute command and implicit

obedience is not attended in Col. Goethals' case with any of what civilians are accustomed to call "fuss and feathers". On the Zone he was never

seen in uniform, and it is said, indeed, that he brought none to Panama. His mind in fact is that of the master, not of the martinet. If he compels obedience, he commands respect and seems to inspire real affection. In a stay of some weeks at Panama during which time I associated in-



Photo by Underwood & Underwood

The upper part shows a 16-inch rifle being tested at Sandy Hook. The gun, which is of the type adopted for the Canal defenses, throws a 2,400 pound shell to an extreme range of 22 miles. It could drop a shell into Wall Street from Sandy Hook. One shell striking a battleship fairly would put her out of business. The lower part of picture shows comparative size of the gun



COL. GOETHALS ENCOURAGES THE NATIONAL GAME

timately with men in every grade of the Commission's service I heard not one word of criticism of his judgment, his methods or even his personality. This is the more remarkable when it is considered how intimately his authority is concerned with the personal life of the Isthmian employees. If one wishes to write a magazine article pertaining to the Canal Zone the manuscript must be submitted to the Colonel. If complaint is to be made of a faulty house, or bad commissary service, or a negligent doctor, or a careless official in any position it is made to the Colonel. He is the Haroun al Raschid of all the Zone from Cristobal to Ancon. To his personal courts of complaint, held Sunday mornings when all the remainder of the canal colony is at rest, come all sorts and conditions of employees with every imaginable grievance.

The court is wholly unofficial but terribly effective. There is no uniformed bailiff with his cry of "Hear ye! Hear ye"! No sheriff with jingling handcuffs. But the orders of that court, though not registered in any calf-bound law books for the use of generations of lawyers, are obeyed, or, if not obeyed, enforced. Before this judge any of the nearly 50,000 people living under his jurisdiction, speaking 45 different languages, and citizens in many cases of nations thousands of miles away, may come with any grievance however small. The court is held of a Sunday so as not to interfere with the work of the complainants, for you will find that on the Zone the prime consideration of every act is to avoid interference with work. The Colonel hears the complaints patiently, awards judgment promptly and sees that it is enforced. There is no system

of constitutional checks and balances in his domain. He is the legislative, judicial and executive branches in one—or to put it less technically but more understandably, what the Colonel says goes. It is, I think, little less than marvelous that a man in the continual exercise of such a power should awaken so little criticism as he. It is true that those who displease him he may summarily deport, thus effectually stilling any local clamor against his policy, but I am unable to discover that he has misused, or even often used, this power.

A young man comes in with an important problem affecting the social life of the Zone. His particular dancing club desires to use the ball room at the Tivoli Hotel on a certain night, but the room was engaged for that date and the other nights suggested did not fit the convenience of the club, so there was nothing to do but to put it up to the Colonel, who put aside the responsibilities of the head of a \$400,000,000 canal job and President of the Panama Railway to fix a date whereon the young folk of that aspiring social club might Turkey trot and Tango to their hearts' content. So far as I know the Colonel has not yet been appealed to by the moralists of the Zone to censor the dances.

Troubles between workmen and their bosses of course make up a considerable share of the business before the court. Once a man came in with an

evident air of having been ill-used. He had been discharged and the Colonel promptly inquired why.

"Because I can't play baseball", was the surprising response of the discharged one, who had been a steamshoveler.



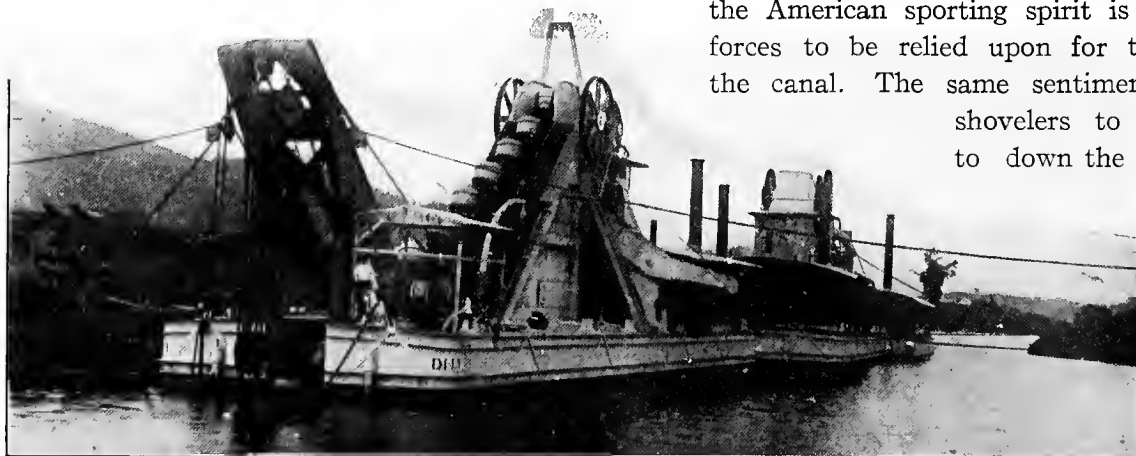
Photo by Underwood & Underwood

THE COLONEL'S DAILY STROLL

It appeared on inquiry that the drill men had challenged the steamshovelers to a match at the national game, and dire apprehensions of defeat filled the minds of the latter because they had no pitcher. At this juncture there providentially appeared a man seeking a job who was a scientific twirler whether he knew much about steamshoveling or not. The American sporting spirit was aroused. The man with the job who couldn't pitch lost it to the man who could but had no job. So he came to the Colonel with his tale of woe.

Now that sagacious Chief Engineer knows that the American sporting spirit is one of the great forces to be relied upon for the completion of the canal. The same sentiment which led the shovelers to use every device to down the drillers at base-

ball would animate them when they were called to fight with the next slide for possession of Culebra Cut. Some employ-



OLD FRENCH LADDER DREDGES STILL USED

ers would have sent the man back to his boss with a curt order of reinstatement—and the shovelers would have lost the game and something of their spirit. So after a moment of reflection the Colonel said quietly to the man:

“They want shovelers on the Pacific end. Go over there in the morning and go to work”.

The feudal authority, the patriarchal power which Col. Goethals possesses over the means of livelihood of every man on the Zone, nay more, over their very right to stay on the Zone at all, gives to his decisions more immediate effect than attends those of a court. The

man who incurs his displeasure may lose his job, be ousted from his lodgings and deported from the Isthmus if the Colonel so decrees. A Jamaican negro came in to complain that her husband took her earnings away from her; would not work himself but lived and loafed on the fruits of her industry. The Colonel ordered the man to allow her to keep her earnings. The man demurred saying sullenly that the English law gave a husband command over his wife's wages.

“All right,” said the Colonel, “you're from Jamaica. I'll deport you both and you can get all the English law you want”.

The husband paid back the money he had confiscated and the pair stayed.

Family affairs are aired in the Colonel's court to a degree which must somewhat abash that simple and direct warrior. What the dramatists call “the eternal triangle” is not unknown on the Zone, nor is the unscriptural practice of coveting your neighbor's wife wholly without illustration. For such situations the Colonel's remedy is specific and swift—

deportation of the one that makes the trouble. Sometimes the deportation of two has been found essential, but while gossip of these untoward incidents is plentiful in the social circles of Culebra and Ancon the judge in the case takes no part in it.

It is not in me to write a character sketch of Col. Goethals. That is rather a task for one who has known him intimately and has been able to observe the earlier manifestations of those qualities that led President Roosevelt to select him as the supreme chief of the canal work. All his life he

has been an army engineer, having a short respite from active work in the field when he was professor of engineering at West Point.

Fortifications and locks were his specialties and fortifications and locks have engaged his chief attention since he undertook the Panama job.

Perhaps it is due to his intensely military attitude that the public has insensibly come to look upon the canal in its quality as an aid to

national defense rather than a stimulus to national commerce. For the

Colonel any discussion of the need for fortifying the canal was the merest twaddle, and he had his way. He begged long for a standing army of 25,000 men on the Zone, but it is doubtful whether he will win this fight. Moreover he would so subordinate all considerations to the military one that he urges the expulsion from the Zone of all save canal employees that the danger of betrayal may be less. How far that policy shall be approved by Congress is yet to be determined. Thus far however the Colonel has handled Congress with notable success and even there his dominant spirit may yet triumph.

Power on the Zone, however, autocratic and absolute, Col. Goethals possesses. It was conferred



A SIDE DRILL CREW AT WORK



THE COLONEL'S FIRE WORKS

A big blast in Culebra Cut. In one year 27,252 tons of dynamite were used

on him formally by the order of Jan. 6, 1908, giving the Chairman authority to reorganize the service at his own discretion, subject of course to review by the President or Secretary of War. The first effect of this was the abolition of a large list of departments with high sounding names, and concentration of their functions in the quartermaster's department with Major C. A. Devol at its head. The Colonel developed in fact a rage for abolishing and concentrating departments. He did not go quite as far as Nero who wished that Rome had but one neck that he might strike off its head at a blow, but he certainly reduced the number of responsible chiefs to such a point that it was easy to place the fault if work lagged or blunders multiplied.

Col. Goethals' first annual report was issued after he had been in command only three months,

covering therefore nine months of the Stevens administration, and was dated at the end of the fiscal year, June 30, 1907. He reported that 80 per cent. of the plant necessary for completing the work was on the ground or had been ordered. When he arrived the high water-mark for excavating in Culebra Cut was 900,000 cubic yards a month, and since his rule began it has never fallen below the million mark, except in May, 1908. It may be noted in passing, that during the first two years of his administration the average for excavation

along the whole line exceeded three million cubic yards a month. During the whole administration of Messrs. Wallace and Stevens only six million yards had been removed. The contrasting figures are given not as reflecting on the earlier engineers, but as indicating the rapidity with which the equip-



PHOTO BY UNDERWOOD & UNDERWOOD

A HEAVY BLAST UNDER WATER

ment and efficiency of the canal organization were increased when the battle of the levels was ended and the civilian commission done away with.

In this report Col. Goethals argued vigorously against turning over the canal work to private contractors — a matter which the President had asked him to report upon in detail. He pointed out that the canal required special

equipment for which no contractor could find use after the expiration of his contract and which therefore the government might just as well buy and own itself. The force of this argument became particularly apparent as the work approached completion. Projects for the utilization of the plant were sent into Congress from every section of the country. It was strongly urged that the plant be sent *en bloc* to Alaska to build railroads and open that rich, but long shut-in territory to settlement and development. Other friends of the reclamation service urged that it be employed in draining semi-submerged lands in the Mississippi Valley and digging irrigating ditches in the Southwest. The floods of the spring of 1913 caused an active demand for its employment on Ohio rivers.

It is fair to note that Mr. Stevens made the first energetic fight for the establishment of the system under which the government owns this colossal and almost invaluable plant, while Col. Goethals' recommendation put upon it the final



Photo by Underwood & Underwood

THE COLONEL'S DAILY MEAL

in the world, erect the mightiest locks that ever raised a ship, and dig a channel through the backbone of a continent, but is quite able to perform the lesser functions incident thereto. It can, and did, successfully conduct hotels and a railroad and steamship line, maintain eating-houses and furnish household supplies. After the Panama exhibit it will take either a brave or a singularly stupid man to preach

stamp of official approval.

This act has importance which will long outlive the construction period of the canal. By the time that work is completed it will have demonstrated beyond doubt that the United States government is perfectly capable of doing its own construction work without the intervention of private contractors; that it not only can build the biggest dam



"THE GOETHALS' OWN" IN ACTION

Attacking a stronghold of the Culebra Slide with a regiment of men and a battery of machines

the ancient dread of a paternalistic government.

Early in Col. Goethals' régime the great department of engineering and construction was split into three subdivisions, namely,

The Atlantic Division, comprising the canal from

deep water in the Caribbean to, and including, the Gatun locks and dam. In all this covered about seven miles of the canal only, but one of its most difficult and interesting features.

The Central Division, including Gatun Lake and the Culebra Cut to the Pedro Miguel lock, or about 32 miles of canal.

The Pacific Division, including the Pedro Miguel and Miraflores locks, and the canal from the foot of the latter to deep water in the Pacific.

Under this classification will be described the construction work on the canal, work which at the time of the author's visit was clear to view, impressive in its magnitude, appalling in the multiplicity of its details, and picturesque in method and accomplishment. With the turning of the water into the channel all this will be hidden as the works of a watch disappear when the case is snapped shut. The canal, they say, and rightly, will be Goethals' monument—though there are those who think it a monument to Col. Gorgas, while quite a few hold

that the fame of Theodore Roosevelt might be further exalted by this work. But whomsoever it may commemorate as a monument it was even more impressive in the building than in the completed form.

One Sunday late in my stay on the Isthmus I was going over the line from Ancon to Culebra. As we approached the little tunnel near Miraflores I noticed an unusual stir for the day, for on the Canal Zone the day of rest is almost religiously observed. Men were swarming along the line, moving tracks, driving spikes, ramming ballast. I asked one in authority what it all meant. "Oh", said he, "we're going to begin running dirt trains through the tunnel, and that necessitates double tracking some of the line. The Colonel said it must be done by tomorrow and we've got more than 1000 men on the job this quiet Sunday. The Colonel's orders you know".

Yes, I knew, and everybody on the Canal Zone knows.



Photo by S. H. Elliott

BAS OBISPO END OF CULEBRA CUT

CHAPTER X

GATUN DAM AND LOCKS



ENTERING the Panama Canal from the Atlantic, one finds the beginning of that section called by the engineers the Atlantic Division, four miles out at sea in Limon Bay, a shallow arm of the Caribbean on the shore of which are Colon and the American town of Cristobal. From its beginning, marked only by the outer-

most of a double line of buoys, the canal extends almost due south seven miles to the lowest of the

Gatun Locks. Of this distance four miles is a channel dredged out of the bottom of Limon Bay and the bottom width of the canal from its beginning to the locks is 500 feet. Its depth on this division will be 41 feet at mean tide. For the protection of vessels entering the canal at the Atlantic end, or lying in Colon harbor, a great breakwater 10,500 feet, or a few feet less than two miles long, made of huge masses of rock blasted along the line of the Canal, or especially quarried at Porto Bello, extends from Toro Point to Colon light. In all it will contain 2,840,000 cubic yards of rock and its estimated cost is \$5,500,000.

In the original plans for the harbor of Cristobal



ENTRANCE TO GATUN LOCKS

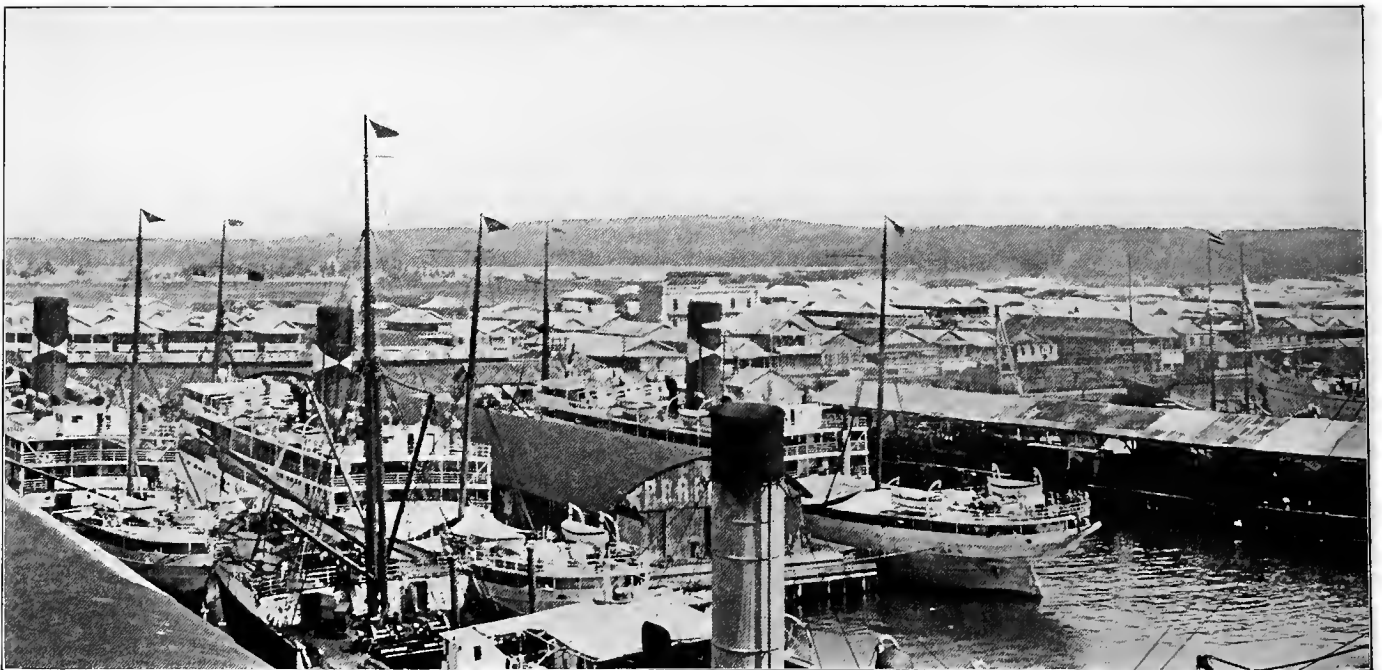
The rafts in the foreground carry pipes through which suction dredges discharge material removed



I. COLON: THESE PICTURES IN ORDER FORM A PANORAMA OF THE COLON WATER FRONT

a second breakwater was proposed to extend at an angle to the guard one, but the success of the former in breaking the force of the seas that are raised by the fierce northers that blow between October and January has been so great that this may never be needed. Its need is further obviated by the construction of the great mole of stone and concrete which juts out from the Cristobal shore for 3500

feet at right angles to the Canal. From this mole five massive piers will extend into the harbor, jutting out like fingers on a hand, each 1000 feet long and with the space between them 300 feet wide so that two 1000 foot ships may dock at one time in each slip. The new port of Cristobal starts out with pier facilities which New York had not prepared for the reception of great ships like the "Vaterland"



III. COLON: PANAMA RAILROAD AND ROYAL MAIL DOCKS



that the work could be done by floating dredges. No novel problems were presented to the engineer, nor are interesting achievements displayed to the tourist until the great dam itself is reached.

The simplest way of reaching the Gatun dam is of course by train from Colon, a ride of perhaps twenty minutes. But a more spectacular one is by launch, either up the Canal, or around by the Chagres River from its mouth. The latter is a difficult trip however and seldom essayed. One advantage of taking the Canal is that it gives a much clearer idea of the construction of the dam than can be derived by approaching it by railroad. The first significant fact forced upon your attention in thus coming upon the dam is that it does not look like a dam at all, but rather like a long and gently sloping hill pierced at one point by a sort of masonry gate which upon closer approach reveals itself as a system of mighty locks.

Not very long ago there was a wide-spread apprehension in the United States, bred of a rather shallow newspaper criticism very widely republished, that the Gatun dam would prove inadequate to the pressure of the waters impounded behind it and might

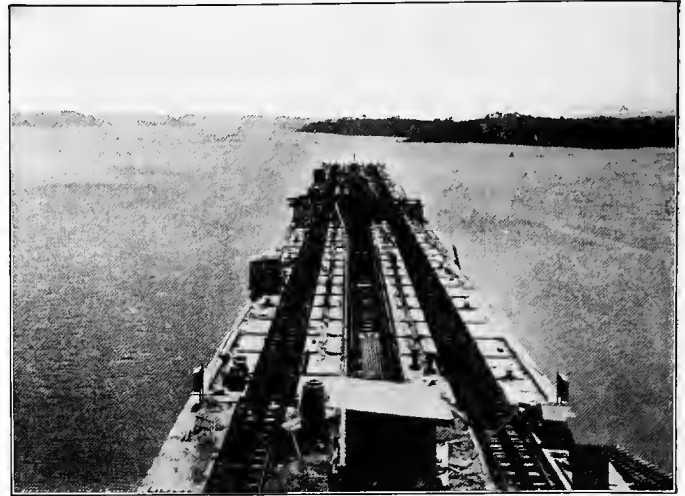
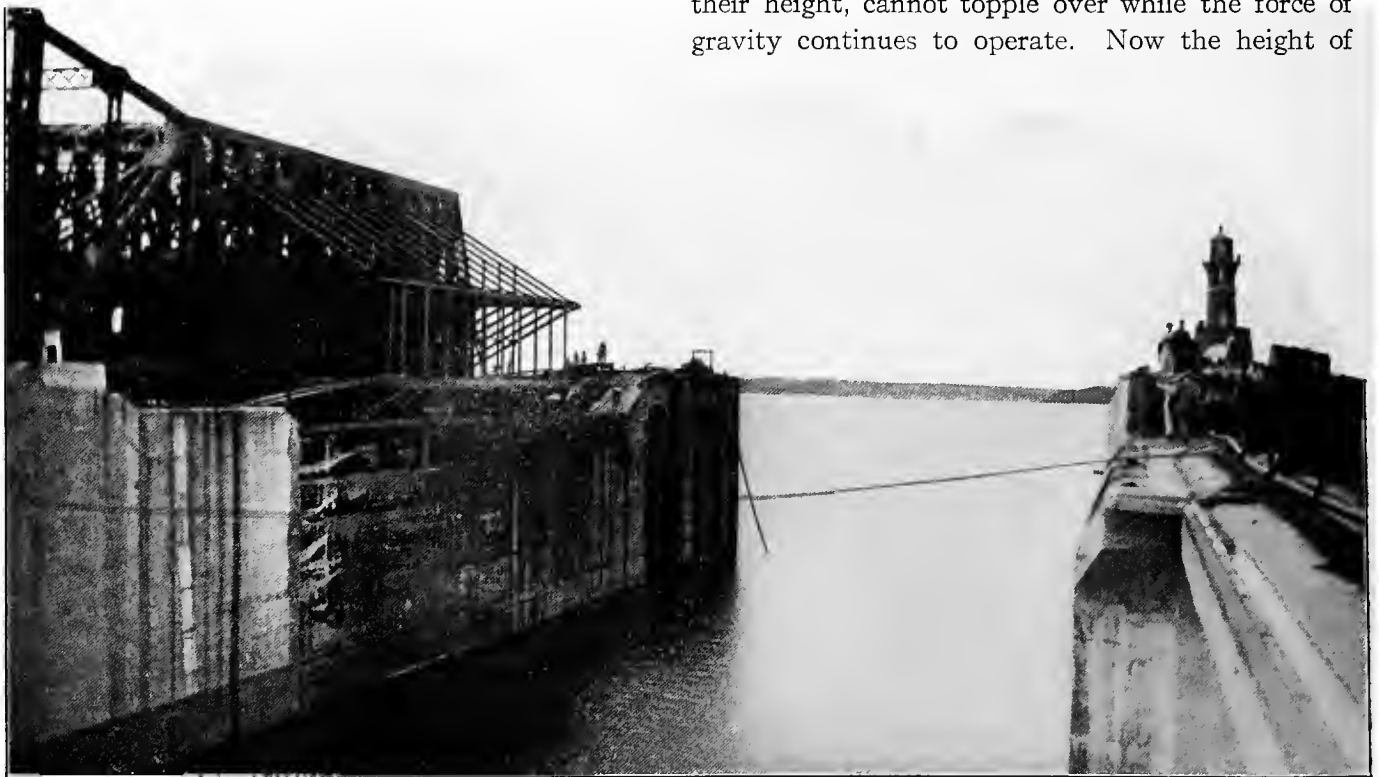


Photo by Underwood & Underwood

SOUTH APPROACH WALL, GATUN LOCKS

collapse, or "topple over". If all who have been impressed by that gruesome prophecy could see the dam itself their apprehensions would be speedily quieted. One might as well talk of toppling over the pyramids, or Murray Hill, New York (not the structures on it, but the hill itself) or the Treasury Building at Washington. Elevations, natural or artificial, the base of which is eight to ten times their height, cannot topple over while the force of gravity continues to operate. Now the height of



GATUN LOCKS OPENING INTO THE LAKE

The skeleton structure on the left is the frame-work of the emergency dam which swings directly athwart the lock

Gatun dam is 105 feet, and from its crest the filling of clay and rock slopes gently away on the landward side for nearly half a mile. There are more abrupt eminences on many of our rolling prairies. The face on the lake side descends somewhat more abruptly, but is still several hundred feet long before its slope ends with the bed of the lake. This face is covered with broken stone down to the "toe"—as they call the walls of rough rock between which the dirt dam was built.

The method of building the dam was simple enough even though it sounds complicated in the telling. When Congress acquiesced in the minority report of the Board of International Engineers, approved by the President and recommending a lock type canal, it meant that instead of simply digging a ditch across the Isthmus we would create a great artificial lake 85 feet above sea level, confined by dams at either ends, with locks and two short canals to give communication with the oceans. To create this lake it was determined to impound the waters of the Chagres, and a site near the village of Gatun, through which the old French canal passed, was selected for this purpose. Conditions of topography of course determined this site. The Chagres valley here is 7,920 feet wide, but the determining fact was that about the center of the valley was a hill of



BIRD'S EYE VIEW OF GATUN DAM

In the foreground the locks, only two of the three steps being fully shown. In the middle distance the spillway, through which surplus water flows into the Chagres and old French Canal

rock which afforded solid foundation for a concrete

dam for the spillway. Geologists assert that at one time the floor of the valley was 300 feet higher than now, and that in the ages the Chagres River cut away the shallow gorges on either side of the rocky hill. These, it was determined, could readily be obstructed by a broad earth dam of the type determined upon, but for the spillway with its powerhouse and flood gates a rock foundation was essential and this was furnished by the island.

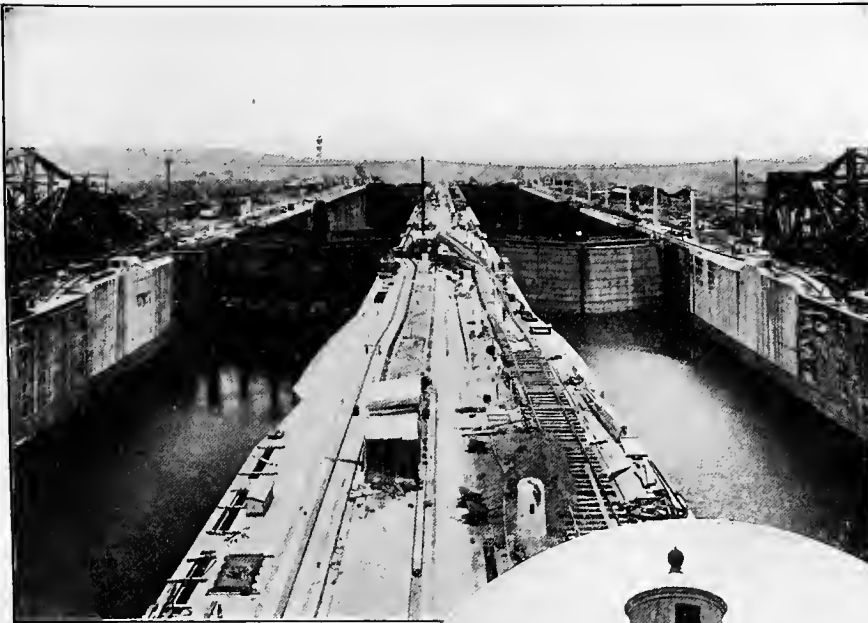
The first step in the construction of the dam was to dam the Chagres then flowing through its old channel near the site chosen for the



Photo by Thompson

GATUN LAKE SEEN FROM THE DAM





GATUN UPPER LOCK

been completed and the spillway was ready to carry off the waters of the Chagres then flowing through the "west diversion" the task of damming the latter was begun. This was the first effort to stem the current of the Chagres, the river dreaded for so many reasons, and the description by Lieutenant Colonel William L. Sibert, the engineer in charge of this division, will be of interest:

"The elevation of the spillway channel is 10 feet above sea level, consequently in any attempt to stop the flow of the Chagres and force it through this channel, a rise of about 14 feet of water had to be encountered. The banks and bottom of the west diversion were soft clay. The plan adopted was to drive trestles across this channel on the 30-foot contour on each face of the dam, and to build, by dumping rock directly into the stream, two dams at the

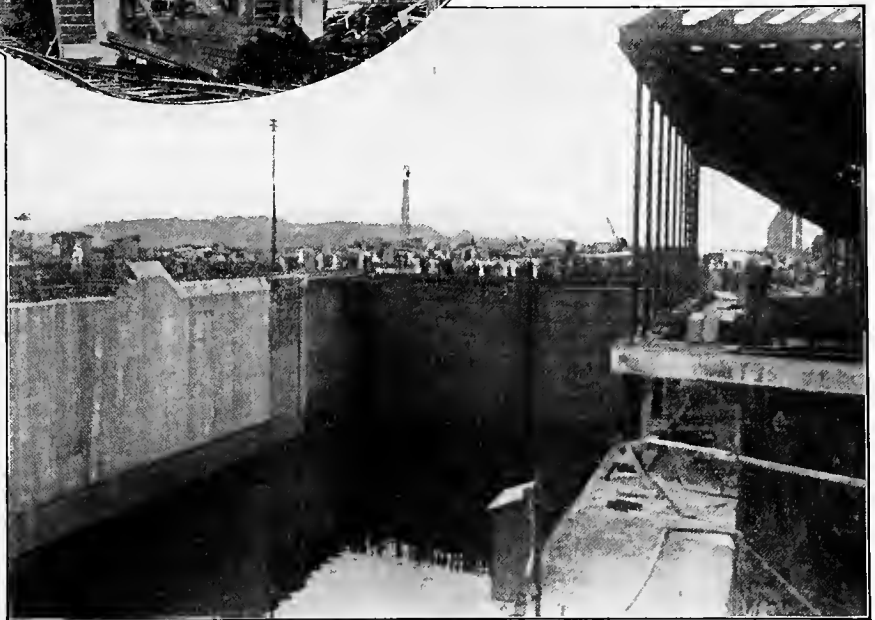
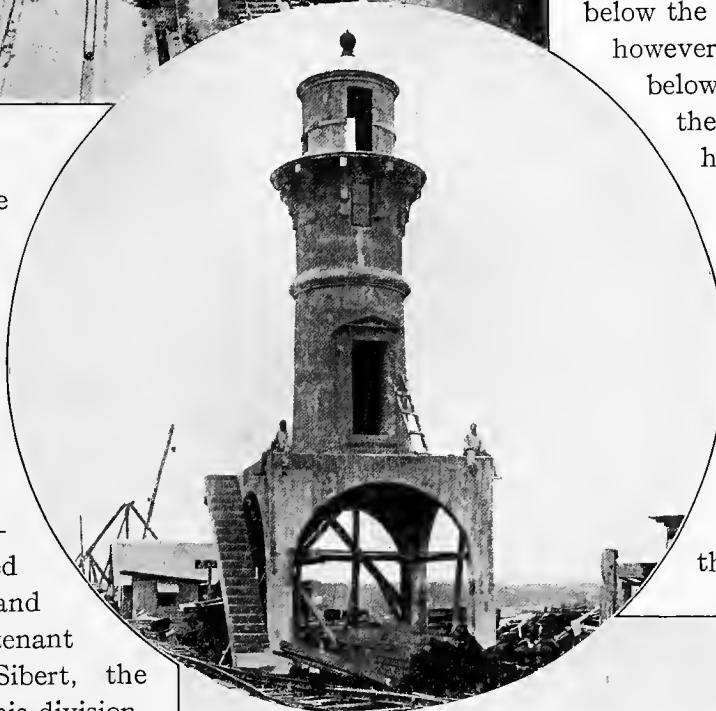


Photo by Underwood and Underwood

CENTER: GATUN CENTER LIGHT; LOWER CORNER: EMERGENCY GATES

same time, hoping to distribute on such dams the head formed during construction. An unlimited amount of waste rock was available for this work. The banks of the channels were first made secure by dumping rock at the end of the trestles. After the channel was contracted to some extent, a considerable current developed; rock dumped from the trestles was carried some distance down stream, forming a rock apron in the bed of the stream below the dam. Quite deep holes, however, were dug by the water below this rock apron. When the work on the two dams had progressed so that a channel about 80 feet wide and 6 feet deep was left in the center, it was found impracticable to make any headway. Stone dumped from the trestles would be rolled down stream. The rainy season was then about to commence.



Photo by Underwood & Underwood

SPILLWAY UNDER CONSTRUCTION

Concrete is dumped directly from the railway into the moulds. Pipes to the power house are shown

The lower part of the bents of the trestles being well supported with rock, it was then decided to dump a carload or two of crooked rails above the trestles in such a way that they would form an entanglement and stop the rock, thus insuring either the construction of the dam or the taking out of the trestle. By this means the two dams were finally completed and the Chagres River successfully diverted."

To the unprofessional observer the Gatun dam is a disappointment as a spectacle. It does not look like a dam at all, but merely like a continuation of one of the hills it connects. But as a matter of fact it is the greatest dam in the world—a mile and a half long, 105 feet high, half a mile thick at its base, 398 feet at the surface of the lake and 100

feet wide at the top. It is longer and higher than the Assouan dam which the British built across the Nile though the latter, being all of masonry, is vastly the more picturesque. Into the entire work will go about 21,000,000 cubic yards of material.

One day while the Gatun dam was in the earlier stages of its construction in 1908, a newspaper correspondent was temporarily detained at Gatun while crossing the Isthmus. Idly, to pass the time away, he strolled out on the dam to where he saw a group of men gathered. He found them discussing a small break at the edge of the dam upstream; a break not caused by any pressure of the water, for the water had not reached that point, but by the weight of the heavy superstructure pressing upon the semi-fluid core of the dam which

then had not had sufficient time for drainage and drying. The dispatch which the correspondent sent north as the result of his casual observation of the slide, was seized upon by the advocates of the sea-level canal as a text from which to argue the entire impracticability of the lake-level project. The agitation became so general and so menacing that President Roosevelt was impelled to appoint a commission of seven engineers of high professional standing and technical knowledge of dam building to visit the spot and report upon the menace. Their verdict was that the Canal engineers had gone far beyond the necessary point in making the dam ponderous and safe. Secretary of War Taft, who happened to be on the Isthmus when the break occurred, declared that it was "insignificant when one takes into consideration the whole size of the dam".

When the tricky Chagres gets on one of its rainy season rages the spillway by which the dam is pierced at about its center will be one of the spectacular points on the Canal line. That river drains a basin covering 1,320 square miles, and upon which

the rains in their season fall with a persistence and continuity known in hardly any other corner of the earth. The Chagres has been known to rise as much as 40 feet in 24 hours, and though even this great flood will be measurably lowered by being distributed over the 164 square miles in Gatun Lake, yet some system of controlling it by outlets and flood gates was of course essential to the working and the safety of the Canal. The spillway is the center of this system, the point at which is the machinery by which the surface of Gatun Lake can be at all times kept within two feet of its normal level, which is 85 feet above the level of the sea.

Fundamentally the spillway is a channel 1,200 feet long and 285 feet wide cut through the solid rock of the island which at this point bisects the now obliterated Chagres Valley. Though cut through rock it is smoothly lined and floored with cement; closed at its upper end by a dam, shaped like the arc of a circle so that, while it bars an opening of only 285 feet, its length is 808 feet. For the benefit of the unprofessional observer it may be noted that by thus curving a dam in the direction



PARTLY COMPLETED SPILLWAY, 1913

The river was low when this picture was taken. At high water it will flow over the completed structure shown at the right

of the force employed against it, its resisting power is increased. It resists force exerted horizontally precisely as an arch resists force, or weight, exerted from above. The dam at the spillway extends solidly across the opening to a height of 69 feet. But this is 16 feet below the normal level of the Lake. From the top of the solid dam rise thirteen concrete

piers to a height as planned, of 115 feet above sea level, that is the piers will rise 46 feet above the top of the dam. Between each two of these piers will be mounted regulating gates of steel sheathing, made water tight and movable up or



Photo by Underwood & Underwood

THE GIANT PENSTOCKS OF THE SPILLWAY

down as the state of the Chagres level requires a free or a restricted passage for the water. Nor will those operating the gates await the visual appearance of the flood before throwing wide the passage for its onrush. At divers points along the Chagres, and throughout its water shed are little stations whence observers telephone at regular intervals

throughout the day to the office at the spillway the result of their observations of the river's height. With these figures at hand the controller of the gates can foresee the coming of a flood hours before it begins to beat against the gates.



THE SPILLWAY AT HIGH WATER

A comparison with the picture on page 179 will show the varying stages of the river

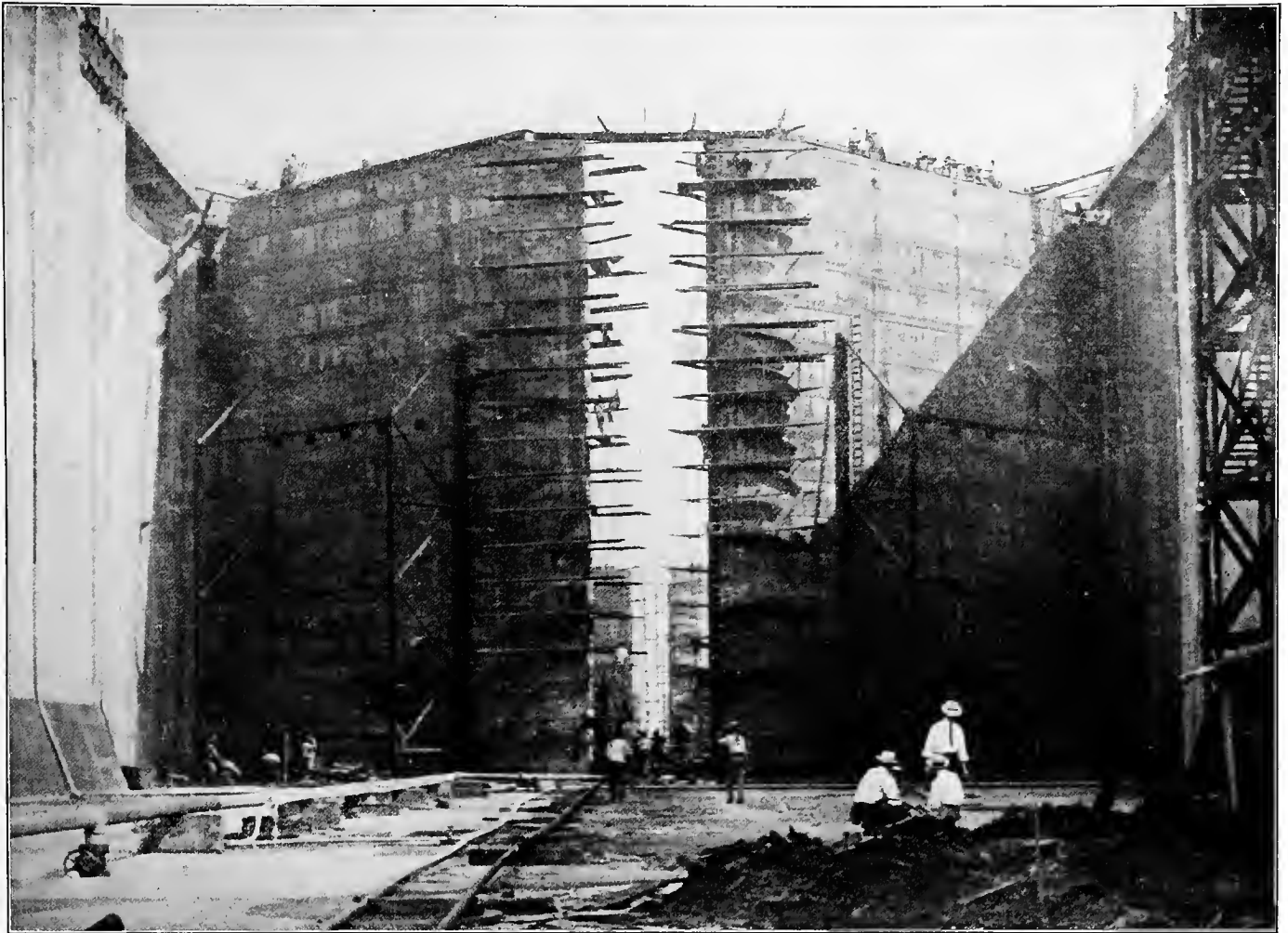


Photo by Underwood & Underwood

LOCK GATES APPROACHING COMPLETION

The spillway further serves a useful and an essential purpose in that it harnesses the water power of the useful Chagres, and turns it into electric power to open and shut the colossal gates of the various locks; to propel the electric locomotives that tow the great ships through the concrete channels; to light the canal towns and villages, and the lighthouses on the line; to run the great cranes at Balboa and Cristobal; to run the machinery in the shops at Balboa; to furnish motive power, if so determined for the Panama Railroad, and to swing the great guns at Toro Point and Naos Island until their muzzles bear with calm yet frightful menace upon any enemy approaching from either the Caribbean or the Pacific. There will be power for all these functions, and power too to light Panama and Colon, to run the Panama tramway and perform other useful functions if the present

grip of private Panama monopoly upon these public services shall be relinquished. The water drops 75 feet through huge penstocks to great turbines in the spillway hydro-electric station with a capacity of 6,000 kilowatts, but the amount of water power is sufficient for double that current, and turbines to supply the addition can be installed whenever the need for the power develops.

The Gatun locks are built at the very eastern end of Gatun dam, at the point where it joins the mainland bordering the Chagres valley. Of their superficial dimensions I have already spoken, and have described their appearance as seen from the deck of a ship in passage. It will be hard however for one who has not stood on the concrete floor of one of these massive chambers and looked upward to their crest, or walking out on one of the massive gates peered down into their depths, to appreciate



THE WATER KNOCKING AT GATUN GATES

they plied, and whole trains of loaded dump cars swallowed up in a single lock chamber, one got some idea of the magnitude of the work. A track for a travelling crane extended down the center of the chamber and the monster rumbled back and forth carrying loads of material to their appointed destinations. Across the whole width of the Canal below the locks stretched cable carriers upheld by skeleton devices of steel mounted on rails so that the pair of them, though separated by 500 feet of space, spanned by the sagging cables, could be moved in unison. Out on the swinging cables ran the loaded

their full size. It is all very well to say that the "Imperator," the greatest of ships now afloat, could find room in one of these locks with five feet at each side, and fifty feet at each end to spare, but then few of us have seen the Imperator and nobody has seen her in the lock. It is all very well to figure that a six story house would not rise above the coping of one of these locks, but imagination does not visualize the house there, and moreover there are stories and stories in height. Yet as one stood on the floor of one of these great monolithic tanks as they were being rushed to completion in 1913, and saw locomotives dwarfed by the ponderous walls betwixt which

cars or buckets, filled with concrete and dumped with a crash and a roar at the chosen place. Giant mixers ground up rock from Porto Bello, sand from Nombre de Dios, and cement from divers states of our union into a sort of Brobdignagian porridge with which the hungry maws of the moulds were ceaselessly fed. Men wig-wagged signals with flags across gaping chasms.



WALL OF GATUN LOCK SHOWING ARCHED CONSTRUCTION

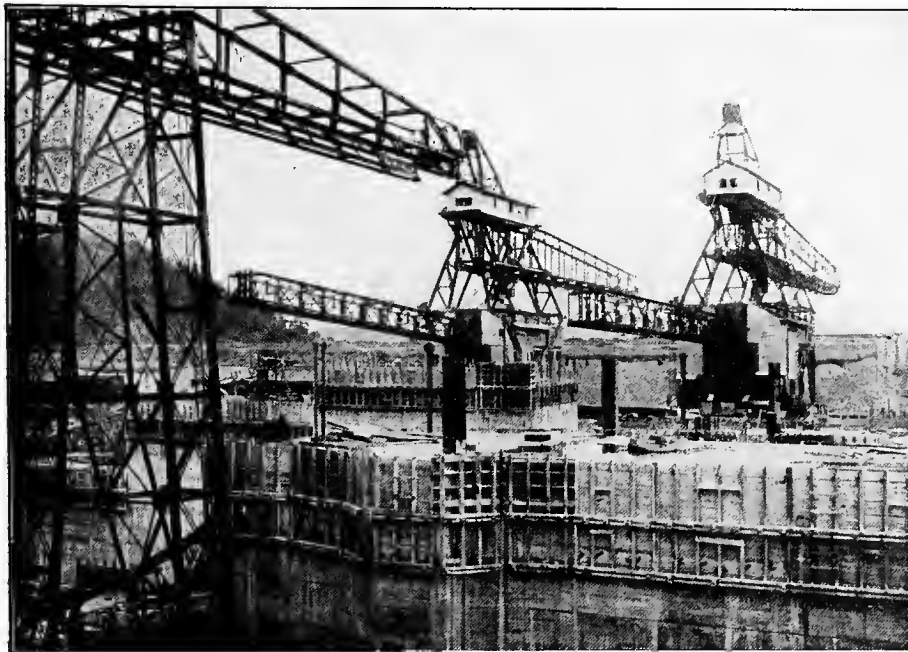


Photo by Underwood & Underwood

TRAVELLING CRANES AT WORK

Mounted on rails these cranes carry the heaviest burdens. Those shown are placed for delivering concrete to the forms. One crane will cost \$60,000

Steam whistles blew shrill warnings and cryptic orders. Wheels rumbled. Pulleys creaked. It seemed that everything a man could do was being done by machine, yet there was an army of men directing, correcting and supplementing the mechanical labor.

Into the locks at Gatun will go 2,000,000 cubic yards of concrete if the original estimate is adhered to. A statistician estimates that it would build a wall 8 feet wide and 12 feet high and 133 miles long—which would just about wall off the state of Delaware from the rest of the Union.

The side walls of each of the locks are practically monoliths, constructed of concrete poured into great steel frames or moulds where it hardens into a solid mass. They are based in the main on bed rock, though it was found on making tests that the bed rock was not of sufficient extent to support the guide walls as well, so one of these is therefore made cellular to lighten

its weight, which rests on piles of 60 feet long capped and surrounded with concrete. This wall was built by slow stages and allowed to stand in order that its settlement might be uniform. An examination of the picture below will make clear the method of constructing the lock walls, for in it are shown the completed monoliths and a steel form half completed with men preparing it for the concrete therein. Col. Sibert describes the details of the work thus:

“The locks proper are founded on rock and the heavy masonry is completed. This rock foundation was not of sufficient extent, however, at available elevations, for supporting the guide walls.

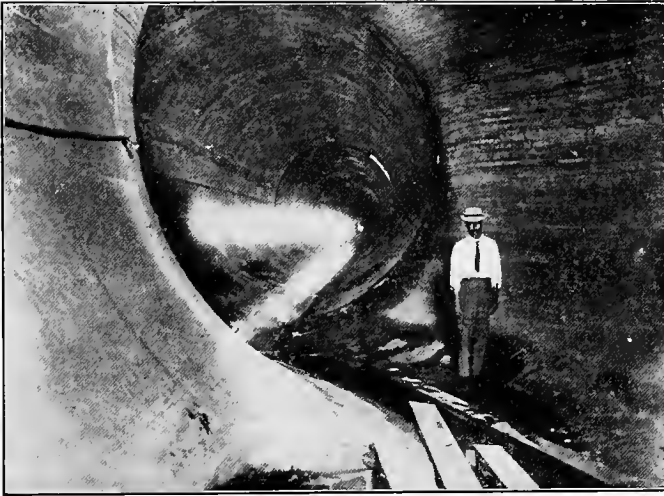
Under that guide wall extending into the lake the underlying rock at the south end is about 150 feet below sea level, and the overlying material is soft. This wall is cellular in construction. It is composed of four longitudinal walls about 2 feet thick with cross walls about 17 feet apart, all built of reinforced concrete.

“The natural ground underlying the wall was about



Photo by Underwood & Underwood

BUILDING A MONOLITH



A CULVERT IN THE LOCK WALL

8 feet above sea level. On this ground a wide fill with a very flat slope was constructed to elevation plus 35, and through this piles about 60 feet long, 4-foot centers, were driven and a heavy reinforced concrete slab built around the heads of the piles, on which was erected the cellular structure. There was a continual slow settlement of this wall as its construction progressed. It was brought to a height of 61 feet above sea level through its entire length in order that the settlement might extend over the whole base before any part was brought to full height.

"The north guide and flare walls are yet to be built. It will be necessary to go to a depth of about 70 feet below sea level through very soft material in order to uncover the rock on which to build the flare walls. Under the guide wall itself the rock is at a still lower elevation, and a pile foundation will probably be constructed, the piling going to rock. The material in this space was too soft to hold up steam shovels, and it was decided to do the general excavation by suction dredges. These dredges cut their way into the space where the walls in question are to be built, making a channel just wide and deep enough for their passage. They then widened out the cut and deepened it to 41 feet below sea level. An earthen dam was then built across the narrow entrance cut,

shutting off the connection with the sea, and as the dredges worked they were lowered. They are now floating at an elevation of 32 feet below sea level and can remove the material to the depth required. After the excavation is completed it is proposed to have the dredges excavate a sump 65 feet below sea level and lower the water to 50 feet below sea level in order to test the stability of the sides of the cut. If there is no sliding the pit will be filled with water; the dredges floated out; the dam across the entrance channel replaced and the excavation unwatered for the construction of the walls first referred to.

"The masonry of the Gatun locks was largely placed by cableways, having a span of 800 feet, covering the entire space to be occupied by the

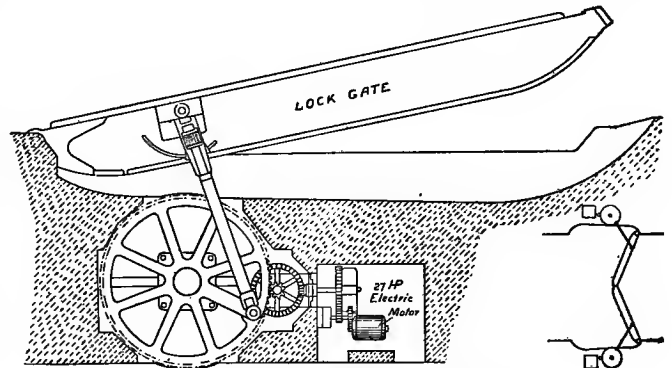
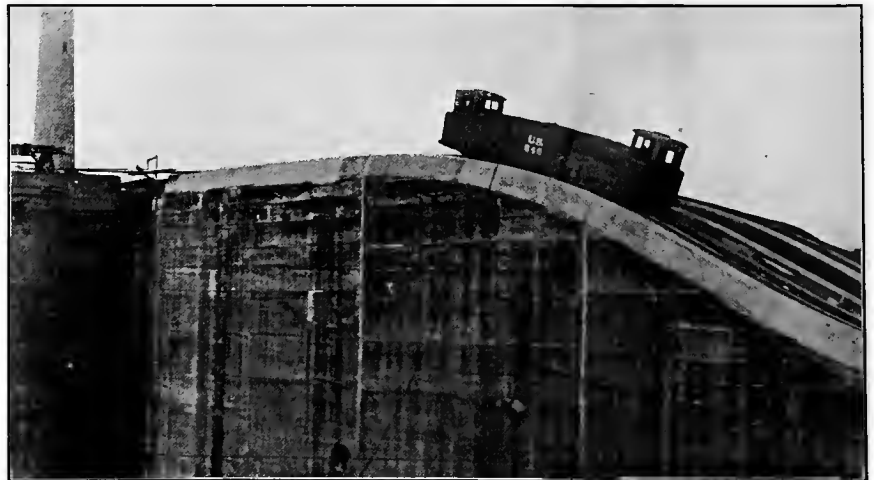


DIAGRAM OF LOCK-GATE MACHINERY

locks. The stone and sand for the concrete were obtained, respectively, 20 and 40 miles down the Caribbean coast, and were brought in barges up the old French Canal as closely as possible to the lock



TOWING LOCOMOTIVE CLIMBING TO UPPER LOCK

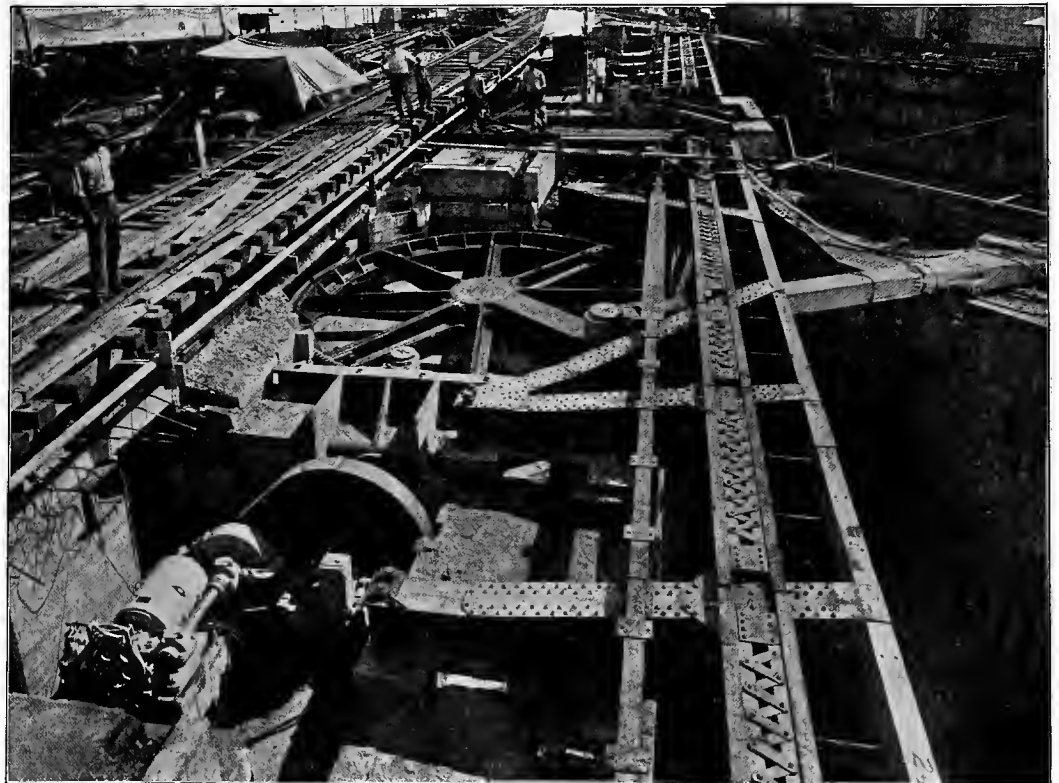
site, and were unloaded by cableways into large stock piles near the bank. The material, however, was still 3,500 feet away and 60 feet below the center of lock construction. This situation caused the adoption of a central mixing plant near the central portion of the locks, consisting of eight 2-yard mixers. An automatic, electric, loop-line railroad, each car carrying the material for a batch of concrete, was installed, passing under the cement shed, under the sand and stone piles; and over the mixers. The mixed concrete was delivered to the cableways requiring it by an electric line, the flat cars of which were handled by electric locomotives. Steel forms were used in constructing the walls of the locks''.

A vital feature of the locks is, of course, getting the water into and out of them, and the method of operating the gigantic gates. The former is simple enough of explanation, though the *modus operandi* will be entirely concealed when the locks are in operation. Through each of the side walls, and through the center walls which divide the pairs of locks, runs a tunnel 18 feet in diameter. To put it more graphically a tunnel large enough to take a mogul locomotive of the highest type. From this main tunnel smaller ones branch off to the floors of the locks that are to be served, and these smaller chutes are big enough for the passage of a farmer's wagon with a span of horses. These smaller chutes extend under the floor of the lock and connect with it by valved openings, the valves being operated by electricity. There is no pumping of the water. Each lock is filled by the natural descent of the water from the lock above or from the lake. By the use

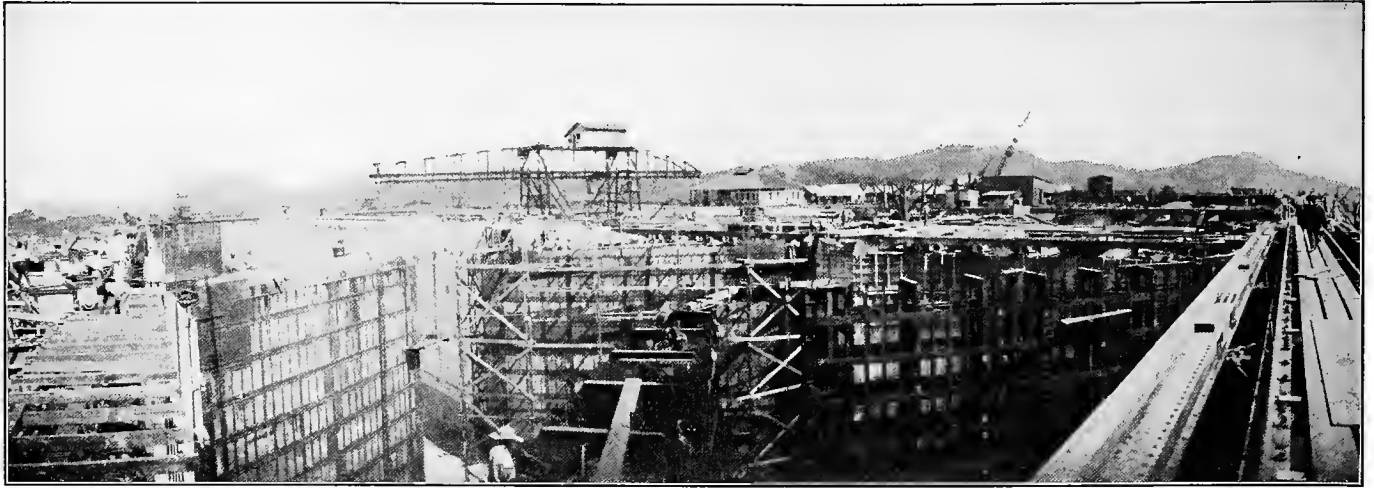
of the great culvert in the central wall the water can be transferred from a lock on the west side of the flight to one on the east, or vice versa. Though it hardly seems necessary, every possible device for the conservation of the water supply has been provided.

We will suppose a vessel from the Atlantic reaches Gatun and begins to climb to the lake above. The electric locomotives tow her into the first lock, which is filled just to the level of the Canal. The great gates close behind her.

How do they close? What unseen power forces those huge gates of steel, shut against the dogged resistance of the water? They are 7 feet thick, 65 feet long and from 47 to 82 feet high. They weigh from 390 to 730 tons each. Add to this weight the resistance of the water and it becomes evident that large power is needed to operate them. At Gatun in the passing of a large ship through the locks, it will be necessary to lower four fender chains, operate six pairs of miter gates and force them to miter, open and close eight pairs of rising stem gate valves for the main supply culverts, and thirty cylindrical valves. In all, no less than 98 motors will be set



THE HEAVY WHEEL SHOWN IS THE "BULL WHEEL"
By its revolution it thrusts or withdraws the arm at the right which moves the gate



THE TANGLED MAZE OF STEEL SKELETONS THAT ARE A LOCK IN THE MAKING

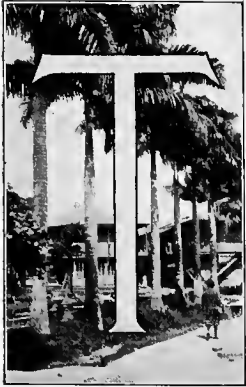
in motion twice during each lockage of a single ship, and this number may be increased to 143, dependent upon the previous position of the gates, valves and other devices. Down under the surface of the lock wall, packed into a little crypt which seems barely to afford room for its revolving, is a great cogwheel 20 feet in diameter, revolving slowly and operating a ponderous steel arm which thrusts out or pulls back the gate as desired. The bull wheel, they call it, is driven by a 27 horse power motor, while a smaller motor of $7\frac{1}{2}$ horse power locks the gates tight after they are once in position. Two of these bull wheels, and two each of the motors are needed for each pair of gates.

The ship then is in the lowest lock, one pair of gates closed tightly behind her. Another pair confronts her holding back the water in the lock above, which if filled, will be just $28\frac{1}{3}$ feet above the surface of that on which she floats. But the water about her is now slowly rising. Another set of electric motors concealed in the concrete wall have set in motion the valves in the floor of the lock,

and the water is flowing in from the tunnels, raising the ship and at the same time lowering the water in the lock above. When the vessel's keel is higher than the sill of the lock above the upper gates swing slowly back and fold in flat with the wall. The ship is now in a chamber 2000 feet long filled to a level. The locomotives pull her forward a thousand feet or so. Again great gates close behind her. Again the water rises slowly about her lifting her with it. The first process is repeated and she enters the third lock. By the time she has been drawn out into the lake and the locomotives have cast her off, more than 100 electric motors with a horse power ranging from $7\frac{1}{2}$ to 50 each will have contributed to her progress. Altogether over 1000 individual motors will be required for the different locks. Indeed the whole interior of those massive lock walls is penetrated by lighted galleries strung with insulated wires bearing a death-dealing current. Men will be stationed at the various machinery rooms, but the whole line of machinery can be operated from a central operating tower on the lock above.

CHAPTER XI

GATUN LAKE AND THE CHAGRES RIVER

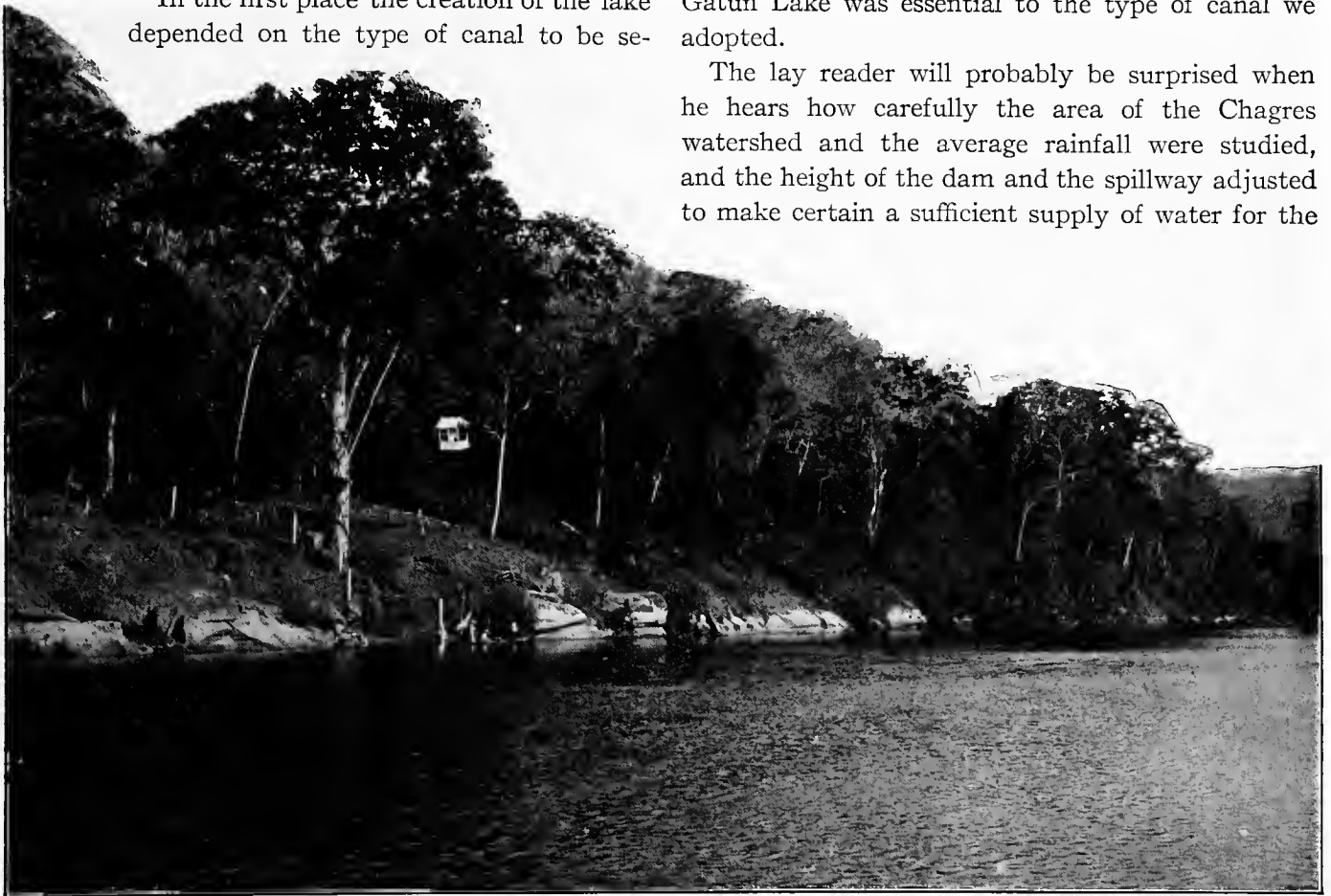


THAT section of the Canal, which for the convenience of engineering records and directions is known as the Central Division, comprises within its boundaries two of the great spectacular features of the Isthmus—Gatun Lake and the Culebra Cut. I have already described the scenic characteristics of this lake, but some discussion of the part it plays in the economy of the Canal will not be out of place.

In the first place the creation of the lake depended on the type of canal to be se-

lected. A sea-level canal could not exist with the lake; a lock canal could not have been built without it. The meanderings of the Chagres, crossing and recrossing the only practicable line for the Canal, and its passionate outbursts in the rainy season made it an impossible obstacle to a sea-level canal, and all the plans for a canal of that type contemplated damming the stream at some point above Gatun—at Bohio, Gamboa or Alhajuela—and diverting its outflow into the Pacific. On the other hand the lock canal could not be built without some great reservoir of water to repeatedly fill its locks, and to supply the waterpower whereby to operate them. Hence Gatun Lake was essential to the type of canal we adopted.

The lay reader will probably be surprised when he hears how carefully the area of the Chagres watershed and the average rainfall were studied, and the height of the dam and the spillway adjusted to make certain a sufficient supply of water for the



THE CHAGRES, SHOWING OBSERVER'S CAR

From the swinging car the observer measures the crest of the flood and rapidity of the current



FLUVIOGRAPH AT BOHIO, NOW SUBMERGED

locks. The only locks with which these could be compared are those at the "Soo", or outlet of Lake Superior. That canal, the busiest one in the world for eight months in the year, averaged 39 lockages a day during that period on the American side and a smaller number through the Canadian locks. The water in Gatun Lake will be sufficient for 41 passages, if the full length of the locks is used or 58 if only the partial length is used, which will be the case with steamships of less than 15,000 tons—and in ships of this class the bulk of the world's trade is conducted. If the limit of 41 lockages seems low, it must be remembered that time is quite as much a factor in the case as is the water supply. It will take an hour and a half to put a ship through the locks. That time therefore technically constitutes a "passage". In the 24 hours there would be 36 passages possible, and under the circumstances that would draw most heavily on the lake there will be water enough for 41.

For the creation of this lake our engineers found the Chagres River available. It had dug the valley in which would be stored the vast volume of water needed, and the unfailing flow from its broad watershed could be relied upon at all seasons—though indeed in the rainy season its contribution is sometimes embarrassingly lavish.

Every land comes to be judged largely by its rivers. Speak of Egypt and you think of the Nile; India suggests the Ganges; England the Thames; and France the Seine. The Chagres is as truly

Panamanian as the Rhine is German and there have been watches on the Chagres, too, when buccaneers and revolutionists urged their cayucas along its tortuous highway. It was the highway by which the despoilers of Peru carried their loot to the Atlantic on the way to Spain, and along its tide drifted the later argonauts who sought the golden fleece in California in the days of '49. The poet too has sung it, but not in words of praise. Listen to its most famous lyric from the pen of James Henry Gilbert.

Panama's most famous bard and most cruel critic.



AUTOMATIC FLUVIOGRAPH ON GATUN LAKE



Photo by Underwood & Underwood

THE VILLAGE OF BOHIO, NOW SUBMERGED

“Beyond the Chagres River
 Are the paths that lead to death—
 To the fever’s deadly breezes,
 To malaria’s poisonous breath!
 Beyond the tropic foliage,
 Where the alligator waits,
 Are the mansions of the Devil—
 His original estates.

“Beyond the Chagres River
 Are the paths fore’er unknown,
 With a spider ’neath each pebble
 A scorpion ’neath each stone.
 ’Tis here the boa-constrictor
 His fatal banquet holds,
 And to his slimy bosom
 His hapless guest enfolds!

“Beyond the Chagres River
 ’Tis said—the story’s old—
 Are paths that lead to mountains
 Of purest virgin gold;
 But ’tis my firm conviction,
 Whatever tales they tell,
 That beyond the Chagres River
 All paths lead straight to Hell”!

A much maligned stream is the River Chagres. Pioneers, pirates, prospectors and poets have vied with each other in applying the vocabulary of contumely and abuse to it, and the practitioners of medicine have attached its name to a peculiarly depressing and virulent type of tropical fever. But the humble native loves it dearly and his homes, either villages of from ten to forty family huts, or mere isolated cabins cling to its shores all the way from Fort Lorenzo to the head waters far beyond the boundary of the Canal Zone. The native too has something of an eye for the picturesque. Always his huts are erected on a bluff of from 15 to 40 feet rise from the river, with the ground cleared before them to give an unblocked view of the stream. Whether by accident or because of a real art instinct he is very apt to choose a point at a bend in the river with a view both up and down the stream. Possibly however art had less to do with his choice than an instinct of self-defense, for in the days of Isthmian turbulence, or for that matter today, the rivers were the chief highways and it was well to



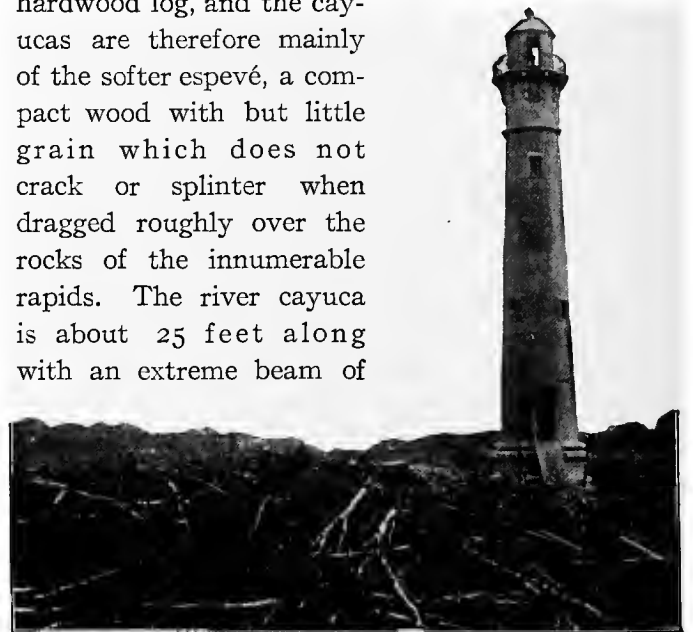
STEPS LEADING TO FLUVIOGRAPH STATION AT ALHAJUELA

This is one of the more distant stations, being ten or more miles outside the Canal Zone

be on guard for hostile forces coming from either direction.

I saw the upper Chagres in the last days of its existence as a swirling stream full of rapids, rushing along a narrow channel between banks sometimes rising in limestone cliffs 60 feet high and capped by dense tropical foliage ascending perhaps as much higher into the blue tropical sky. The river was at its best and most picturesque as at the opening of the dry season we poled our way up from Matachin towards its source. Then Matachin was a hamlet of canal workers, and a weekly market for the natives who brought thither boat loads of oranges, bananas, yams and plantains. Sometimes they carried stranger cargoes. I heard a commission given one native to fetch down a young tiger for somebody who wanted to emulate Sarah Bernhardt in the choice of pets. Iguanas, the great edible lizard of Panama, young deer, and cages of parrots or paroquets occasionally appear. But as a market Matachin is doomed, for it is to be submerged. With it will go an interesting discussion of the etymology of its name, one party holding that it signifies "dead Chinamen" as being the spot where imported Chinese coolies died in throngs of homesickness during the construction of the Panama Railroad. But the word also means "butcher" in Spanish and some think it commemorates some massacre of the early days. However sanguinary

fashioned usually from the trunks of the espevé tree, hollowed out by fire and shaped within and without with the indispensable machete. It is said that occasionally one is hewn from a mahogany log, for the native has little idea of the comparative value of the different kinds of timber. Mahogany and rosewood logs worth thousands of dollars in New York are doing humble service in native huts in Panama. But the native has a very clear understanding of the comparative labor involved in hewing out a hardwood log, and the cayucas are therefore mainly of the softer espevé, a compact wood with but little grain which does not crack or splinter when dragged roughly over the rocks of the innumerable rapids. The river cayuca is about 25 feet along with an extreme beam of



A LIGHT HOUSE IN THE JUNGLE

its origin there will presently be water enough to wash out all the stains of blood. In 1913 the place was one of the principal zone villages, with large machine shops and a labor colony exceeding 1500 in number. All vanishes before the rising lake, which will be here a mile wide.

The native craft by which alone the Chagres could be navigated prior to the creation of the lake are long, slender canoes

about 2½ feet and a draft of 6 to 10 inches. Naturally it is crank and can tip a white man into the stream with singular celerity, usually righting itself and speeding swiftly away with the rushing current. But the natives tread it as confidently as though it were a scow. For upstream propulsion long poles are used, there being usually two men to a boat, though one man standing in the stern of a 30-foot loaded cayuca and thrusting it merrily upstream, through rocky rapids and swirling whirlpools is no uncommon sight.

Our craft was longer—35 feet in all, and in the official service of the Canal commission had risen to the dignity of a coat of green paint besides having a captain and a crew of two men. Our captain, though but in his nineteenth year, was a person of some dignity, conveying his orders

to the crew in tones of command, though not averse to joining in the lively badinage with which they greeted passing boatmen, or rallied maidens, washing

linen in the streams, upon their slightly concealed charms. The corrupt Spanish they spoke made it



Photo by Underwood & Underwood

THE RIVERSIDE MARKET AT MATACHIN

difficult to do more than catch the general import of these playful interchanges. Curiously enough the native peasant has no desire to learn English, and

frequently conceals that accomplishment, if he has attained it, as though it were a thing of which to be ashamed. This attitude is the more perplexing in view of the fact that the commission pays more to English speaking natives.

"This boy Manuel", said my host to me in low tones, "understands English and can speak it after a fashion, but rarely does so. I entrapped him once in a brief conversation and said to him, 'Manuel, why don't you speak English and get on the roll of English speaking employees? You are getting \$62.50 gold a month now; then you'd get \$75 at least'.

"Manuel dropped his English at once. 'No quiero aprender a hablar ingles', said he, 'Para mi basta el espanol'". (I don't care. Spanish good enough for me.)

Manuel indeed was the son of the alcalde of his

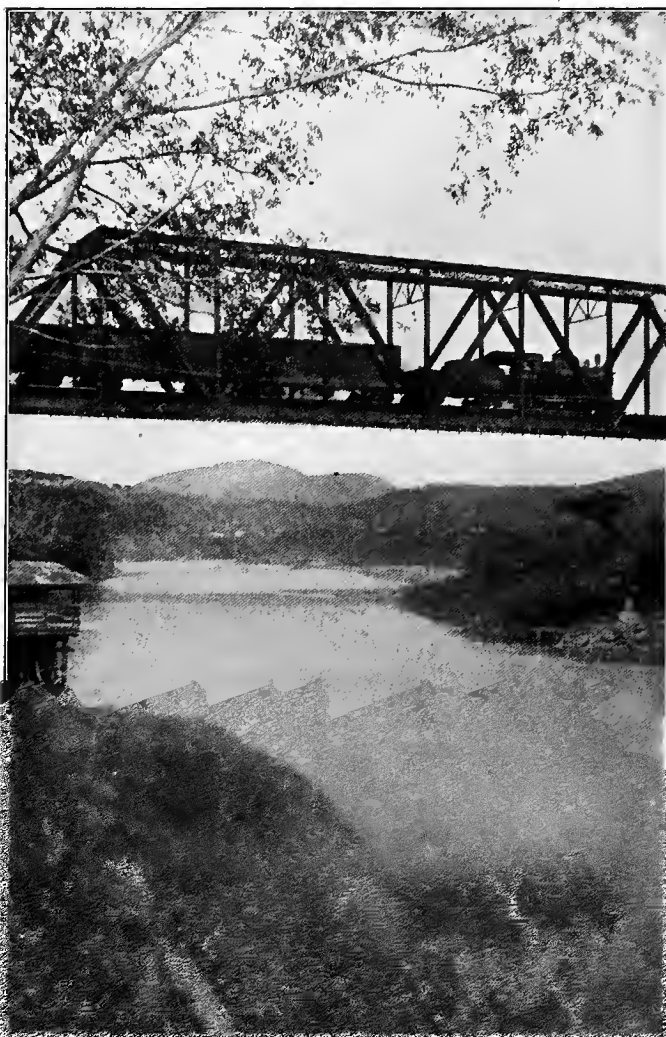
village, and the alcalde is a person of much power and of grandeur proportionate to the number of thatched huts in his domain. The son bore himself as one of high lineage and his face indeed, Caucasian in all save color, showed that Spanish blood predominated over the universal admixture of negro. He saved his money, spending less than \$10 a month and investing the rest in horses.

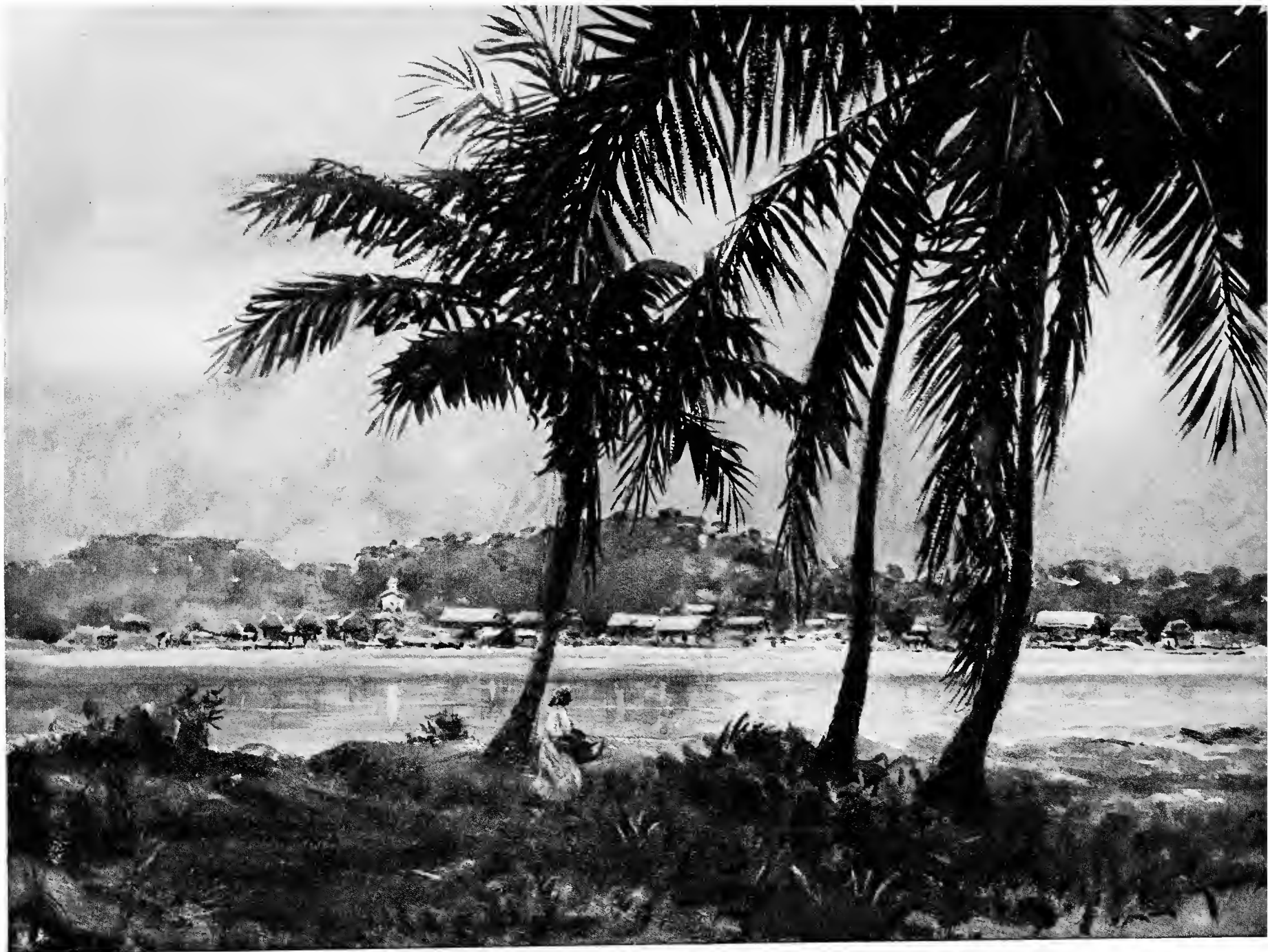
From Matachin up to Cruces the river is comparatively commonplace, spanned at one point by the Gamboa bridge up at which the voyager looks reflectively from below

as he hears that when the spillway is closed and the lake filled up there will be but 15 feet headway above the river's crest, where at the moment there is more than 60. Higher up are the towers, housing the machinery for recording the river's rise, one of them a relic of the French régime, while a slender wire spanning the stream carries the pendulo s car in which observers will go out at flood time to measure the height of the tide's crest and the height of the water. A stream of many



A QUIET BEACH ON THE CHAGRES





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THE RIVER AND VILLAGE OF CHAGRES

The little hamlet of rude thatched huts with a frame Catholic church in the middle has seen history in its time. The Spanish fortress of San Lorenzo on the hill was taken by Sir Henry Morgan's buccaneers and later by the British under Admiral Vernon after hard fighting.

formation concerning sudden rises we shall always be under great obligations to the French. Their hydrographic observations and records are invaluable, and their stations established before we assumed control are still used, with much of their machinery. Stations are maintained far up the valleys of the Chagres and tributary rivulets, and all are connected with the central control at Gatun dam by telephone. Some of the stations are equipped with automatic machinery which, in the event of a rise during the night summons the keeper by ringing an alarm bell. The life of the keeper of a fluviograph station, miles perhaps of jungle isolating him from the nearest human habitation, is lonesome enough. Yet its monotony is sometimes relieved by lively incident. The irascible Chagres, for example, once caught the keeper at Alhajuela with a sudden rise, and compelled him to camp out a night and day in a tree top and see his house, pigs and poultry swept away on the rushing tide. There was a fair chance that the tree would follow.

On our way up the river to visit some of the fluviographs we landed at Cruces, went a brief space into the jungle and cleared away with machetes the tangled vegetation until the old trail, or Royal Road to Panama, was laid bare. Three to four feet wide or thereabouts it was, and



POLING UP THE RAPIDS

at points rudely paved with cobble stones. The nature and dimensions of the trail show that it was not intended for wheeled carriages, and indeed a native vehicle is a rarity on the Isthmus today, except in the towns. Time came when with the growing power and cruelty of the Spaniards this Camina Reale, or King's Highway, was watered with the blood of Indian slaves, bearing often their own possessions stolen from them by the Spaniard who plied on their bent backs his bloody lash. It may have been over this trail that Balboa carried, with incredible labor, the frames of three ships or caravels, which he after-

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Photo by S. H. Elliott

CONSTRUCTION WORK ON THE SPILLWAY

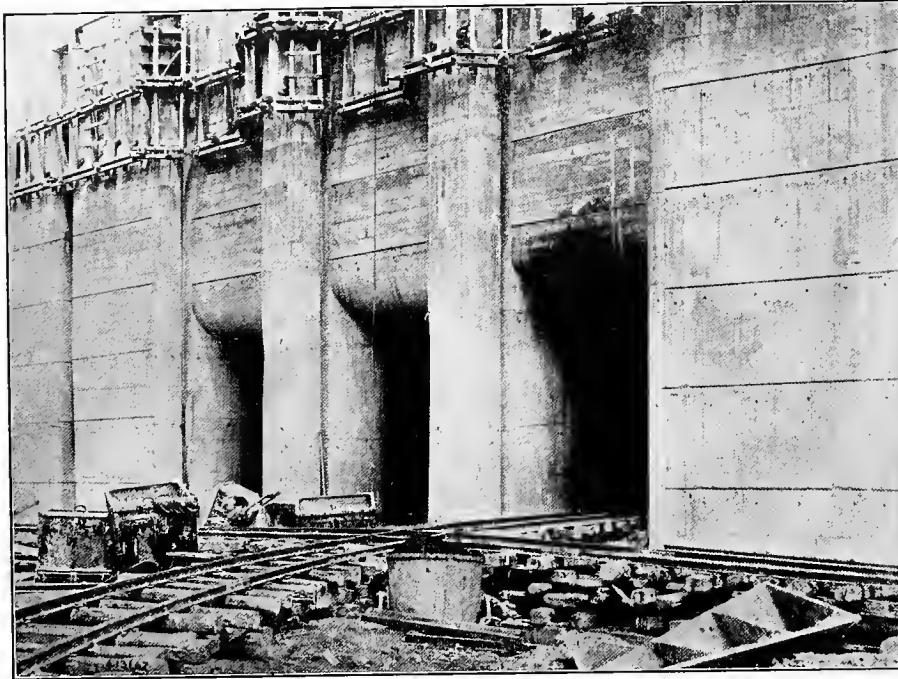


Photo by Underwood & Underwood

WATER GATES IN LOCK WALL

Through these gates the water is admitted to the great conduit in the center wall of the lock

wards erected and launched in the Pacific. Several years ago there were found in the jungle near Cruces two heavy anchors, with 14-foot shafts and weighing about 600 pounds which had been carried thus far on the way to the Pacific and there dropped and left to the kindly burial of the tropical jungle. When they were discovered a too loyal graduate of our military academy at West Point in charge of some engineering work on the Isthmus, thought it would be a fine thing to send them up there and have them preserved on the parade ground of the academy. Without announcing his intention he had them removed from the spot where they were found and had taken them as far as the steamship wharf at Colon when Col. Goethals—who has a habit of hearing of things that are not

announced—quietly interfered. The anchors were removed to some safe spot and in due time will form part of the historic decorations of the new city of Balboa.

Doubtless by the standards of these days the wealth that was carried back and forth along the Royal Road by men crushed low like termite ants beneath their heavy burdens, was not great. Yet one gets some idea of the volume of the trade from Bancroft's statement that in the year 1624, just four years after the landing of the Mayflower, goods to the amount of 1,446,346 pesos d'oro (practically an equal number of dollars), were registered at the Casa, or custom house, while

probably $7\frac{1}{2}$ millions of dollars' worth of goods were smuggled through. There were great warehouses then and a stone church with a neighboring monastery to which it was customary to send the children of the richer people at Nombre de Dios to be kept until they had attained their seventh year. For that piously named town was almost a plague spot

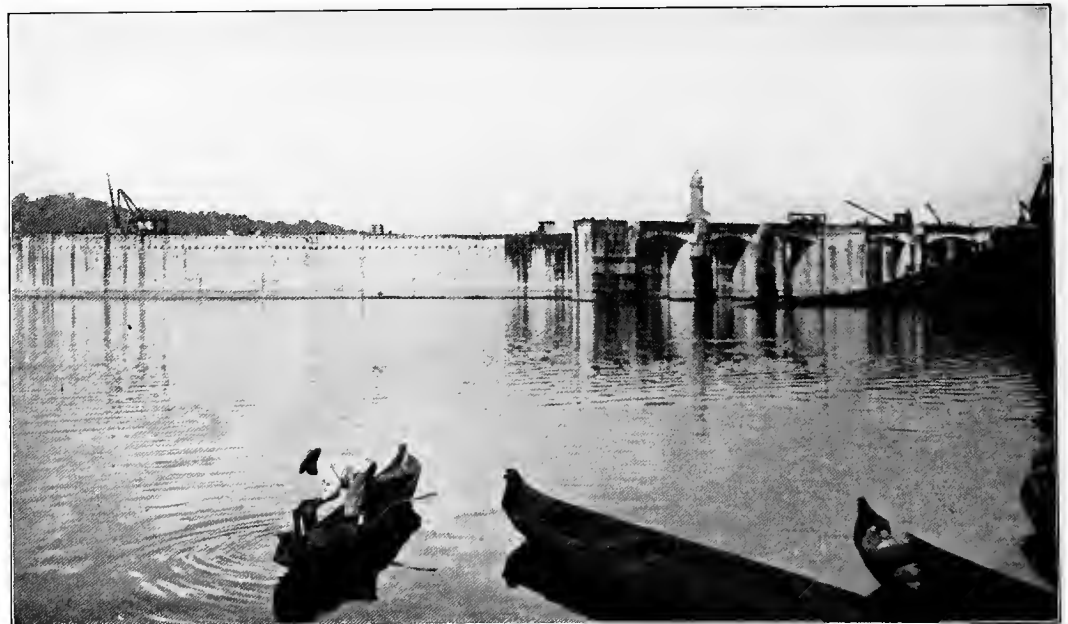


Photo by Underwood & Underwood

THE LAKE ABOVE GATUN

and its miasmatic atmosphere was fatal to tender infants.

The paved trail echoes no more with the muleteer's cry, or the clatter of hoofs, nor are there wine shops to tempt the traveler, for there are none to be tempted. But even in its palmiest days Cruces could have been but a dismal spot. Gage, a soldier of fortune and an itinerant preacher, visited the village in 1638 and left us this record:

"Before ten of the clock we got to Venta de Cruces where lived none but mulattoes and blackmores who belong unto the flat boates that merchandize to Portobel. There I had much good entertainment by the people who desired me to preach unto them the next Sabbath day and gave me twenty crownes for my sermon and procession. After five days of my abode there, the boats set out, which were much stopped in their passage down

the river, for in some places we found the water very low, so that the boats ran upon the gravel; from whence with poles and the strength of the blackmores they were to be lifted off again".

After the lapse of almost four centuries we found the shallows still there and the blackmores—or their descendants—ready to carry our boat past their fall. But the people who paid the early traveler twenty crowns for a sermon had vanished as irrevocably as the city's public edifices, and no descend-

ants of like piety remain. Morgan's fierce raiders swept through the village in 1670, and its downfall may have begun then, for the stout Protestantism of the buccaneers manifested itself in burning Catholic churches and monasteries in intervals of the less pious, but more pleasing, occupation of robbing the Spaniards or torturing them to extort confessions of the hiding places of their wealth.

Sir Henry Morgan, however, was not the only famous man of battles to pass through Cruces. In



HOW THEY GATHER AT THE RIVER

1852 a very quiet young captain in the army of the United States, one Ulysses S. Grant, was there in command of a company of the Fourth Regiment of Infantry, U. S. A., proceeding from New York to San Francisco. Cholera broke out among the men and the loss while on the Isthmus was heavy. At Cruces the men were detained for days, the roster of the sick growing daily, while rascally contractors who had agreed to furnish mules to the army sold them at higher prices to private parties eager to



WASHERWOMEN'S SHELTERS BY THE RIVER

For protection against the burning sun they erect small shanties of palms

get away from the pest hole. According to the surgeon's report the situation was saved by Grant, who made a new contract and enforced it—the latter being a practice that grew on him in later days.

For a brief space in the days of the gold rush to California in 1848-'54, Cruces bade fair to regain its early importance. Once the half-way place on the trail of Spaniards marching to steal gold from the Peruvians, and Englishmen following to rob and murder the robbers in turn, it became the meeting place of prospectors going out to California full of hope, and of miners returning, some laden with gold but more bowed with disappointment. Again Cruces became the point at which people and freights were transferred from the river to the trail, or vice versa. But another trail reached the river's bank at Gorgona and this village became a considerable rival to the older and larger place higher up stream. Here were several rambling wooden houses dignified by the name of hotels of which no trace remains today. The whole village, a considerable one in the

spring of 1913, with a population of at least 3,000, is to be abandoned to the rising tide of Gatun Lake, and such portions of it as escape submergence by the water will be overwhelmed by the equally irresistible jungle.

Charles T. Bidwell, an English traveler who crossed the Isthmus in 1853 by way of the Gorgona route, says of the pleasures of a sojourn in that town, "The place contained a few stores and more drinking saloons, most of which were kept by the 'enterprising Tan-kee'. The Gorgona road to

Panama was just then open, it being passable only in the dry season, and it was estimated that 2,000 persons had passed through this place on their way to or from California. * * * We decided to take the Gorgona road and arranged to have saddle mules ready in the morning to convey us to Panama for \$20 each and to pay 16½ cents a pound additional for the conveyance of our luggage". (The distance now by rail, which closely follows the old trail is 16 miles, the fare 80 cents.) "We then went to inspect 'a free ball' which had been got up with all available splendor in honor of some feast, and



A FERRY ON THE UPPER CHAGRES

here we had a rare opportunity of seeing assembled many shades of color in the human face divine; a gorgeous display of native jewelry and not the most happy mixture of bright colors in the toilettes of those who claimed to be the 'fair sex'. Dancing however, and drinking too, seemed to be kept up with no lack of spirit and energy to the inharmonious combination of a fiddle and a drum; and those of the assembly whose tastes led them to quieter pursuits had the opportunity of losing at adjoining gaming tables the dollars they had so easily and quickly extracted from the travelers who had had occasion to avail themselves of their services. These tables too were kept by the enterprising Yankee. Having seen all this, and smoked out our cigars, we sought our beds, when we found for each a shelf or bunk in a room which our host boasted had at a push contained twenty-five or thirty people. * * * On awakening at daylight I found a basin and a pail of water set out in the open air on an old pianoforte, which some traveler had probably been tempted to bring thus far on the road".

The writer goes on to say that it took a little over two days to traverse the distance to Panama, the guides having stolen the mules they had rented and made off during the night.

Above Cruces the banks of the Chagres begin to rise in perpendicular limestone cliffs, perhaps 60 or 70 feet high while from their crests the giant tropic trees, the wild fig, the Panama, the Ceiba and the sentinel rise yet another one hundred feet into the bright blue sky. Amongst them flash back and forth bright colored parrots and paroquets, kingfishers like those of our northern states, only

gaudier, and swallows innumerable. Up and down the river fly heavy cormorants disturbed by the clank of the poles among the stones of the river bottom, but not too shy to come within 50 feet or so of our boat where, much to my satisfaction, there is no gun. White and blue herons stand statuesque in the shallows with now and then an aigret. Of life other than feathered one sees but little here. A few fish leaped, but though the river was crystal-line and my guide assured me it was full of fish I saw none lurking in either deeps or shallows. Yet he must have been right for the natives make much



Photo by W. T. Beyer

THE MUCH PRIZED IGUANA

This lizard, which attains a length of five feet, is esteemed a delicacy in Panama

of fish as an article of diet, catching them chiefly by night lines or the unsportsmanlike practice of dynamiting the stream, which has been prohibited by the Panama authorities, although the prohibition is but little enforced.

Now and then an alligator slips lazily from the shore into the stream but they are not as plentiful here as in the tidal waters of the lower river. Occasionally, too, a shrill cry from one of our boatmen, taken up by the other two at once, turns attention to the underbrush on the bank, where the ungainly form of an iguana is seen scuttling for

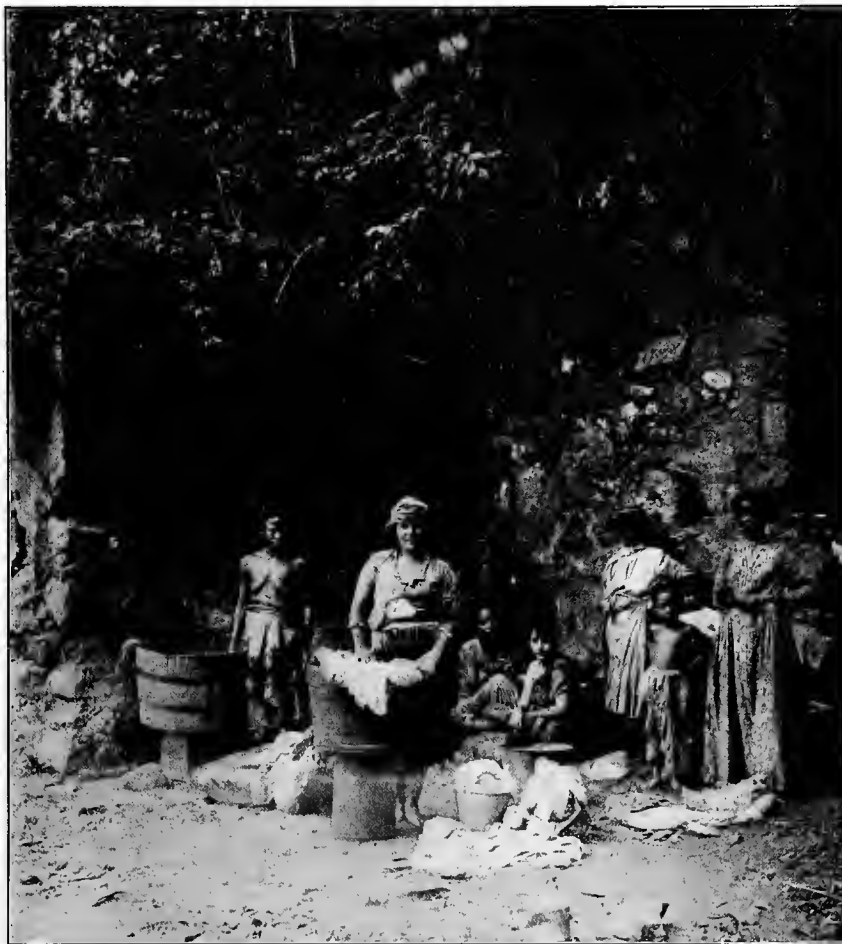
Alhajuela. The keeper was a native of the Canary Islands who had mastered English sufficiently to make his reports over the 'phone. His wife, who greeted us in starched cotton with a pink hair ribbon, pink shoes and a wealth of silver ornaments, was a native, dark of complexion as a Jamaica negress, but her sister who was there on a visit was as white as a Caucasian. Doctors on the Zone say that these curious variations in type in the same family are so common that they can never foretell within several shades, the complexion of a baby about to be born.

The keeper of this station was paid \$65.50 monthly and the Commission supplied his house, which was of the native type and cost about \$85. Though many children, pickaninnies, little Canaries or whatever clustered about his door, his living expenses were practically nothing. Expense for clothing began only when the youngsters had reached 11 or 12 years of age and thereafter was almost negligible—as indeed were the clothes. The river furnished fish, the jungle iguanas, wild pigs and birds; the little garden patch yams, bananas, mangoes and other fruits. He was far removed from the temptations of Matachin, or other riotous market places and he saved practically all of his pay. His ambition was to get enough to return to his native isles, buy a wine-shop and settle down to a leisurely old age—though no occupation could

much outdo for laziness the task of watching for the rising of the Chagres in the dry season.

Returning from the upper waters of the Chagres one reaches Gatun Lake at Gamboa where the railway bridge crosses on seven stone piers. A little above is a fluvigraph station fitted with a wire cable extending across the stream and carrying a car from which an observer may take measurements

of the crest of any flood. Indeed the river is watched and measured to its very sources. It long ago proved itself unfit for trust, and one who has seen it in flood time, 40 feet higher than normal, bearing on its angry, tawny bosom houses, great trees, cayucas stolen from their owners, and dead animals, sweeping away bluffs at bends and rolling great boulders along its banks, will readily understand why the builders of the Canal stationed scouts and



THE NATIVES' AFTERNOON TEA

spies throughout the Chagres territory to send ample and early warning of its coming wrath.

Leaving the Chagres, turning into Gatun Lake and directing our course away from the dam and toward the Pacific end of the Canal, we traversed a broad and placid body of water interspersed with densely wooded islands, which very soon narrows to the normal width of the Canal. In midsummer, 1913, when the author conducted his inspection, a broad dyke at Bas Obispo cut off Gatun Lake and its waters from the Canal trench, then dry, which



PIERS OF THE ABANDONED PANAMA RAILWAY

here extends in an almost straight line, 300 feet wide, through steadily rising banks to the continental divide at Culebra. The railroad then crossed upon this dyke to the western side of the Canal and passed through several construction towns and villages, abandoned later when the Canal was filled and the railroad moved to the other side. Tourists with an eye for the spectacular used to stand on this dyke and speculate upon the thrilling sight when a huge blast of dynamite should rend the barrier, and in a mighty wave the waters of Gatun Lake should rush down the broad channel betwixt

the eternal hills to make at last the long desired waterway from Orient to Occident. But unhappily Col. Goethals and his associates unsentimentally put the picturesque aside for the practical. No dynamite blast, no surging charge of waters through the cut, entered into their program. Instead with mighty siphons the water was to be lifted over the barrier and poured into the Canal for days until the two bodies of water were nearly at a level. Then by the prosaic use of floating dredges the dyke would be removed and the Canal opened from Gatun Locks to the locks at Pedro Miguel.