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THE
PANAMA CANAL
AND THE
DAUGHTERS OF DANAUS

BY
JOHN BIGELOW

1908

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*Rusticus expectat dum defluat amnis : ut ille
Labitur, et labetur in omne volubilis ævum.
Epistolæ Horatii I. 2. 43.*

*He who defers the hour of reform, like the
fabled rustic, waits for a river to run dry
that rolls on forever.*

SECOND EDITION
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PREFACE TO THE SECOND EDITION

WHILE the first edition of this pamphlet was in the printer's hands, the announcement was made of Colonel Goethals' intention to suppress the dams recommended by the President on the Pacific side, and with them the so-called Sosa Lake. As the technical reasons were fully ten times more weighty for the suppression of the Gatun dam and lake, I seem to have allowed the reader to infer that the suppression of the one was merely a prelude to a corresponding suppression of the far more reprehensible Gatun earth dam on the Atlantic side, which the President himself pronounced "risky." In this I was mistaken, for it now appears that Colonel Goethals proposes to prosecute that work, though so many times more unstable and insecure than the ones Major Goethals rejected for their instability and insecurity on the Pacific side of the Isthmus. I jumped too hastily to the conclusion that the Gatun dam in due time would share the fate of the other. This error will be found corrected on pp. 36, 37, 38. I leave it to Colonel Goethals to reconcile a principle of construction which is true on the Pacific side of the Isthmus but false on the Atlantic side, conditions being similar.

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BEFORE the present Federal Congress separates, about four years will have elapsed since the property of the French Panama Canal Company became the property of the United States. The prosecution of that work was then confided by the President, nominally at least, to the War Department. The present time seems, therefore, opportune for a consideration of the progress of this imperial enterprise and to cast our horoscope for the year if not the day when the world will be invited to assist at the nuptials of the Atlantic and Pacific oceans.

On the twentieth of August last, Lieutenant-Colonel Goethals, the present Chief Engineer of the canal, wired the Secretary of War that, "The works scheduled for the fiscal year ending June 30, 1908, can be finished three months earlier—that is, by the thirtieth of next March"; but for that purpose recommends that an emergency appropriation be asked from Congress in time to avert any cessation of construction. The amount of this emergency appropriation, as announced by the Panama Canal Commissioners, is \$8,000,000. On the twenty-seventh of August, the Acting Secretary of War wires Mr. Goethals that the President approves of his "creating a deficit" in the manner proposed.

As this document of Colonel Goethals is likely to occupy not a little of the serious attention of Congress, it is given here at length as printed in the "Canal Record," an official periodical issued weekly "under the authority and supervision of the Isthmian Canal Commission."

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Secretary of War,
Washington:

CULEBRA, Aug. 18, 1907.

Construction work for this fiscal year is developing faster than was contemplated. Report of expenditures for July shows we are exceeding monthly allowance for labor and have already obligated, very largely, appropriation for material. Results are being obtained in proportion to increased expenditure and with lower unit cost. With present organization and programme, Canal can be completed more rapidly than by keeping within appropriations now available. As compared with last year's appropriation for construction, we have one million dollars less for labor, and the same for material, notwithstanding largely increased demands due to the necessity of starting new work on the Chagres Division, and relocation on the Panama Railroad for which no allowances were made. Work on locks and dams on each terminus has been opened up and should be pushed vigorously this year. Very little was expended at these points last year. *Time of completion of Canal now appears to depend on work at Gatun, progress at Gatun dam dependent on removal of present railroad track to new location. In order to lay concrete in locks next year, plant must be contracted for this year, but appropriation not sufficient.* If in accordance with Revised Statutes 3679, request authority to continue expenditures in excess of pro rata monthly allowance on account of present necessities and unforeseen developments since estimates were submitted, with understanding that Congress will be requested to make additional appropriation to cover the deficiency at next session. Additional funds required for construction this fiscal year, four millions for labor and four millions for material; total, eight millions. This is required, not as an increase of cost of Canal, but in order to work faster. If not approved, request to be informed as soon as possible so that work can be reduced and expenditure kept within present appropriations.

GOETHALS.

I

We now know that at the end of June next, 1908, there will have been expended on the Panama Canal by our government \$ 79,608,568.58

As the President has authorized a subordinate in the War Department to approve of the emergency appropriation, it is already being spent whether constitutional or not— 8,000,000.00
which gives a total of expenses to the close of the current fiscal year of \$ 87,608,568.58

The total cost of the lock canal with a summit level at eighty-five feet above the sea, as estimated by the Isthmian Canal Commission in its report of 16th November, 1901, was to be \$144,233,358.00

Deducting from this the generous sum specially allowed for engineering, police, sanitation and other contingencies, of 24,038,893.00

there would remain for expenditures on the canal proper \$120,194,465.00

The same commission in their report of 1901 decided that the canal they proposed could and ought to be finished in ten years, the two years consumed in preparations inclusive.

The canal which was advised by the minority of the consulting board assembled in Washington in 1905 by the President, and which the President recommended, is also a lock canal, with a summit level at eighty-five feet above the sea. It differs from the canal of 1901, on the plans of which the construction was begun in May, 1904, by a different location of the dams and locks.

It has been stated that the time and cost of construction would remain practically the same for both forms of canal. It has been also stated that all the works made prior to the modification of plans were also useful for the new plans and that no time nor money would be lost by this modification. Therefore we are entitled to depend on the original figures relating to cost and time in order to judge the results actually obtained.

Four years plus two months will have elapsed on the thirtieth of next June. On the Isthmian Canal Commission's estimates the following will be the proportion of expenditures that should have been incurred and work done for the completion of the canal within the promised period of ten years:

As the expenses for sanitation, engineering, police, etc., must largely be made in proportion to the time lapsed, four tenths of \$24,088,893, say \$9,600,000, ought to have been spent on that account next June.

This would leave at that date a total expenditure of \$78,000,000 for the works alone.

This sum represents exactly six and a half tenths of the total sum of \$120,000,000 provided for the works.

Colonel Goethals asserted in his telegram that his request for more funds did not mean an increase of cost of the canal above the estimates. He must, therefore, be prepared to show to Congress that at the end of June next:

First. Six and a half tenths of the Gatun dam across the valley of the Chagres River, or 5000 feet of its length of 7700 feet—in other words considerably more than half—had then been built.

Second. That nearly four of the six huge twin locks to be provided should then also be complete and ready for ships and commerce.

Third. That of the remaining 54,000,000 of cubic yards of excavation left by the French Company to be made, 35,000,000 cubic yards should have been excavated by our engineers.

We will now turn to the "Canal Record" to ascertain what portion of this work has been done or will be done two months after the expiration of the fourth year of our management of it.

First. Of the six and a half tenths of the Gatun dam to be built, thus far not a load of stone or a shovelful of dirt has been contributed to it. It is of this work that Mr. Goethals said in his reported application for an emergency appropriation just quoted, that "the time of the completion of the canal now appears to depend on the work at Gatun, not on the excavation of the canal."

Hitherto the Culebra cut and the control of the Chagres have been the lions in the path of this canal. This rashly projected dam is now for the first time presented as a terror more formidable than either of the others, and the work of subjugating it is not yet begun. We learn by the "Record" of September 18th that "*it is hoped to start the construction dam before the first of January.*"

Second. Four of the six huge twin locks required should be nearly ready for use within less than half a year, according to the money spent. Yet not a block of stone has been cut for one of them. According to the "Record" of September 4th, "It is believed that the actual masonry work can be commenced at the Gatun locks within eighteen months"—that is, the first stone may possibly be laid in March, 1909. So recently as the twentieth of October last, the Canal Commission submitted to the Secretary of the Navy the question of widening the locks, so that it is doubtful if even the plan and dimensions of the locks can be settled before February, 1909.

Third. Of the 54,000,000 cubic yards of excavation in the Culebra hill, upon which most money has been spent and the Government's force ought to have been concentrated as exclusively as practicable from the beginning, at least 35,000,000 should have been removed in June, 1908. Of this, however, but 7,812,186 cubic yards had been removed at the end of June last. It is now apparent that there will not have been extracted on the thirtieth of June next, according to the average yearly output, but at the most about 17,000,000 cubic yards; barely one half of the output which the money expended requires. Even this small output has been obtained for the most part in simply widening, without deepening the cut as left by the French Company. Indeed, the public has no evidence that the cut has been deepened an inch. When Colonel Goethals begins to deepen the cut he cannot expect to maintain even his present moderate output, except at a prodigious increase of expense, for every foot the trench is deepened, the greater the risk of slides and the accumulated volume of torrential rains which unsettle the roadbed almost as fast as the rails can be replaced.

At the pace of expenditure during the present fiscal year of \$34,000,000, following an expenditure of \$26,000,000 last year, it would not be safe to reckon upon an expenditure of less than \$40,000,000 a year in future; which means that by the autumn of 1909, or say scarcely a year and a half from the thirty-first of June next, 1908, the total sum which the Panama Canal was estimated by the President's engineers to cost, will have been expended, and certainly less than one third of the projected work completed.

II

It deserves to be remarked that the expenses incurred on this canal have not been swollen, as in the case of a private corporation, by brokers' fees, by interest on capital, by costs of advertising or commissions of any kind; that it was not confronted at the beginning, as the De Lesseps Company was, by a virgin forest. On the contrary, the whole line of the canal was studded with workshops, dwellings, much costly material, roads of access and service, not to

speak of an enormous collection of technical documents of great value. Besides, it was equipped with the prophylactics with which modern science has armed the canal-diggers, since the beginning of this century, against the malignant fevers with which the French Company had constantly to contend; yet, with all these advantages, physical and financial, enjoyed by us, we are forced to the humiliating admission that the De Lesseps Company, the life of which terminated so disastrously for its stockholders, spent considerably less money for the work accomplished than we have done. During the eight years of their control of the canal, from the third of March, 1881, to December, 1888, their average annual expenditure for the work done was twenty millions of dollars to execute seventy-two million cubic yards of excavation in seven years and nine months. Our Government between the moment it came into the possession of the French property and March last, have spent an annual average of sixteen millions of dollars to execute in two years and eleven months only six million cubic yards of excavation—a difference which shows that the French Company on an average had about four times more return of work for the money spent than our Government had in that time.

President Roosevelt, in his Message of December, 1906, and shortly after his return from his naval promenade to Panama, stated: "The French excavating machines, though of excellent construction, are mere toys when compared with the new steam shovels, just as their wagons for removing the excavation resemble the toys of children when compared to the long trains of platform cars which empty themselves that we employ." He adds: "In the season of rains our steam shovels cannot do much in the movable earth, but they work constantly in the rock or in the hard ground."

The President could apply to the enormous cars what he says of the steam shovels, and add, that in excavating the movable earth they would regularly be off the rails instead of on them. If the French Panama Company had as recklessly measured the weight of its locomotives and cars by the greatness of the cut, regardless of the ground and the rains, by adopting the American machinery which first took its place, it would not have done anything during nine months of every year. The President himself admits that these machines do nothing in movable earth during rains. Most of the trenches at the time of the French occupation were of soft

clay, while the Americans' work of to-day has been for the larger part in hard clay and rock.

The President evidently did not take sufficient account of these facts or he would have hesitated to compare to toys the mechanical system which, twenty years ago, excavated, with half the number of men than are now employed, in the three last years of the old Company's existence 1,400,000 cubic yards a month, while the so-called superior American machinery now employed, at a quadruple expense, had given as a maximum up to the time of the President's message but a cube of 325,000 cubic yards per month, or less than one third of the cube officially announced in April previous by the President of the Isthmian Canal Commission as the expected monthly excavation of the second half of 1906—1,000,000 cubic yards.

In the three days the President spent on the Isthmus he was naturally too much occupied with the festivities awaiting him to inform himself that there were at that very time one hundred French locomotives *toying* in the canal, while only thirty-nine American ones were "making the dirt fly"; that there were also at the same time 541 French dump-cars toying for the children of the Zone, and but 324 genuine dirt-flying American dump-cars.

Had his Excellency, when crossing from Colon to Panama, felt as much interest in the subject as he exhibited a few weeks later in his Message to Congress, and consulted the Superintendent, he might have learned that there were at that very time exactly as many French as American locomotives—twenty-four—operating the railway on which he was riding.

While on this subject, it may be well to call the reader's attention to the recent resurrection of "a French elevator dredge which had been lying," according to the official "Canal Record," in the Rio Grande above La Boca for more than twenty years, and for \$20,000 "has been restored in every part so that it is now capable of excavating 120,000 cubic yards of material per month, an amount equivalent to that removed by four ninety-five-ton, five-yard steam shovels. This dredge," the "Record" adds, "when in service at the La Boca entrance of the canal will do more work than a modern dipper-dredge costing \$102,500. . . . The engine which had remained in the jungle near Sam Pablo for more than twenty years was in excellent condition and could not be surpassed by modern machinery, both as to adjustment and economy

of operation. The copper piping on all the machinery is of very heavy design and shows much more careful workmanship than is found in modern machinery. The remarkable preservation of this machinery was due in the first place to *the high quality of the material used* in construction, and in the second place to the use of white lead and grease which excluded the air."

Referring to this dredge, in the "Record" of October 9th, it says:

"Her performance is even more satisfactory than was anticipated. The engines and transmission machinery run smoothly, the control is simple and effective, and the consumption of coal economical for the power developed. . . . Owing to the long haul, the mud barges working with the dredge *are unable to dispose of all the material that could be removed by this machine.* Arrangements are being made to add new barges to the fleet. *One French barge has been re-built and the work of overhauling another has begun.* When this shall have been done, the output of the dredge will be considerably increased.

"Another old French dredge of similar type is now being repaired in the Crystobal dry dock, and will probably go into commission about the last of October."

We have been waiting nearly four years to discover that twenty-six years ago the French employed dredging machines superior to those we have provided. Now we see, if we consult the recent report of the Isthmian Canal Commission for 1906-1907, what our dipper-dredges have proved their capacity for doing.

On page 50 we find that:

"The new five-yard dipper-dredge, similar to those ordered for the Colon dredging division, was accepted, and commenced operation at noon, May 20, 1907, in the channel in the vicinity of the wharf [La Boca]. From May 20 to June 30 it was operated twenty-two working days, during which time it excavated 22,300 cubic yards of material."

In the same space of time one old despised French dredge would have excavated 150,000 cubic yards, say about six times what our so-called "modern dredge" could do.

So recently as the twenty-fifth of December the "Canal Record"

reports, "Work was continued on ten old French locomotives and fifty old French dump-cars in order to put them in condition for service."

And yet more recently, on the first of January, the "Record" tells us that "The Sanitary Department has recently called the attention of the Chief Engineer to two seventy-five-ton coal-barges lying in the Rio Grande where they had been *abandoned*. These barges are in fairly good condition and can be economically rebuilt. It is thought it will not be a difficult matter to float them out during high water in the river.

"Because of the special design of these old French barges they have the same advantages as ships built with a double bottom, and are structurally very strong and practically unsinkable. The space between the bottom of the barge and the bottom of the hold, with the lateral bulkheads, forms airtight compartments, so that if a hole were knocked in the hull by a collision, or even if the hull itself were cut in two, the barge would float. This feature of construction has proved its usefulness on several occasions."

The ignorance of our engineers about dredging soft ground is still darker when the question of dredging hard ground comes.

The September excavation of 1907, reports Mr. Goethals, was the largest which had then ever been made—1,481,297 cubic yards. Unfortunately, of this output 403,852 were dredged in Colon and 144,625 in Panama—in all 548,477, not in the Culebra but in the low and marshy levels of the coasts, and, like so much of the two previous months, may, part or all, have to be handled again for the construction of the dams, or be wasted, leaving the Culebra output for this month but 763,286 cubic yards.

Could the whole of the output be credited to the Culebra, it would still be ridiculous to treat the result as a triumph over the old French Company, as the organ of the Canal Commission persists in doing. The latter achieved their average monthly output of 1,400,000 during 1886–1887 and 1888, with but 15,000 operatives; we, for a feebler average, with practically little if any yellow or Chagres fever to war upon, with sea-going suction-dredges propelled by twin screws costing without their equipment over \$362,000 apiece, had about 40,000 men on our payroll.

It may here be remarked parenthetically that the Ancon, which is the name of the first of these powerful and costly dredges, has been employed ever since its arrival at the canal entrance in Li-

mon Bay, not in the Culebra cut, and when loaded, steams out to sea to discharge its cargo off Toro Point. The others by this time are doing the same kind of inopportune and wasteful work.

It will be many years—six at least—by the rate it has been progressing, before the bottom prism of the canal will be cut to the level of forty feet above the sea in the Culebra in order to obtain a water level at eighty-five feet. I apprehend it will be no easy matter for those who ordered this expenditure of \$1,086,000 for suction-dredges to explain to the satisfaction of Congress why they were ordered so soon, or when ordered they were set to work when and where it was impossible to utilize their output. Of course, the policy of protecting our infant industries requires that no money should lie in the Treasury long enough to prompt the plain people to ask whether some of their taxes might not be lightened by a reduction of the tariff; but that not being one of the policies for which the Washington Government stands at present, are there not plenty of other uses for our accumulating millions, from which the country some day might derive some advantage?

If, as the scientists say, dirt is matter out of place, then these costly machines are in a dirty business, the more dirty because the only other apparent motive than the one just referred to for dredging Limon Bay at this time is to swell the amount of output and mislead Congress and the public about the value of what is really being done at the Isthmus.

The only excuse I have for dwelling thus long upon the comparative achievements of the French and the American canal-diggers on the Isthmus is that, from the very inception of the work by our Government, it has manifested a fear that there would not be glory enough to go round if any credit whatever was conceded for what, during their many years' occupation, the French engineers had done toward proving the practicability of piercing the Cordilleras by an oceanic channel.

It will be hard to persuade any person who knows Colonel Goethals that either he, or any officer of his rank in the American army, would, of their own motion, have diverted men and machines from the work where most required merely for the ignominious purposes of imposing upon and obscuring the judgment of the legislative branch of the Government. No one knows better than they also that it is no part of the business of a Government commission to vaunt the superiority of its engineers over any others,

foreign or domestic, even when they shall have demonstrated the fact, which this Commission has not yet done, nor shown any likelihood of doing. Nor is it their business to cook canal statistics in a way to disguise either their lack of skill or their extravagance, but to build the canal as expeditiously and inexpensively as possible—precisely that and nothing but that. This nation is building a canal to facilitate the commerce of the world and to multiply its industrial resources, not that we may taunt the French for not accomplishing twenty years ago what they failed to accomplish only for lack of the Government support to which it was justly entitled, while our Government at that very time was making efforts for another Isthmian Canal which, but for the Herculean efforts of a French engineer, would have proved infinitely more disastrous to us than the French Company's collapse proved to them. What that Company had actually done for a canal we thought worth to us, and gave \$50,000,000, in addition to the proof which they and they only could furnish, that the Panama route was the only practicable trans-continental canal route. Nor must we ever forget that but for a French engineer's superior judgment and active interference, we would have now been embarked upon another canal enterprise upon which we would have spent hundreds of millions before discovering that it was still-born and could never be trusted to take on its bosom a ship or a steamer.

And now my readers, if any are so patient as to have followed me thus far through this dreary Serbonian bog, may be provoked to ask if we are to despair of having a trans-continental canal, or are we to be bankrupted in digging it? To these questions I answer that I do not despair of our having a stable, ample, and permanent canal, but not in this generation, if even in the next, unless prosecuted by other methods than those recommended by the President and by which it has been and is still operated.

I must here be indulged with some reminiscences which will explain, and I hope may excuse my meddling publicly with problems the solution of which are usually and properly supposed to belong exclusively to professional engineers.

III

IN the month of February, 1886, in response to an invitation addressed by the late Count Ferdinand de Lesseps, the projector and the President of the Panama Canal, to the Chambers of Commerce of the maritime world to meet him at the Isthmus and inspect the progress of the great enterprise he was then prosecuting there, I accepted an invitation from the New York Chamber of Commerce to act as its representative on that occasion. I had been upon the Isthmus but two or three days before I realized the necessity of asking President de Lesseps if he could not put me into communication with some officer to whom I might with propriety apply for such information about the works as I required, without troubling him. The Count was no longer a young man; like myself he was not an engineer nor of course familiar with the details about which I was seeking light. "Certainly," he replied, "I will present to you the best man for your purpose that we have. He knows more about the canal work than any one else on the Isthmus." Presently, and obviously at his behest, a young gentleman approached and was presented to me. In presenting him the Count said to him with some emphasis, "Mr. Bunau-Varilla, you will please give Mr. Bigelow all the information he asks of you about the canal, without any reservations whatever," or words to that effect. The following morning I submitted to this gentleman, with whose name the world is now familiar, a series of questions which I had prepared on my voyage from New York, remarking at the same time that it would be a better economy of his time as of mine, for him to take the questions and underwrite his answers during his moments of leisure, than for us to sit down together to the work; for I saw that he was a very busy man, though I did not then dream, what I afterward learned, that he was only twenty-six years of age, and at the time was not only Engineer in Chief of the whole work, with from ten to fifteen thousand men under his command, but had the exclusive charge of the forty or fifty delegates who were to be slept, fed, transported about the Isthmus, and individually enlightened in regard to a complex system of works of which few of them could boast, more than myself, of having even an elementary knowledge. I did not then, nor until some three months later, learn Mr. Bunau-Varilla's age or official position and importance. Shortly after the guests of Count de

Lesseps left the Isthmus, Mr. Bunau-Varilla had been stricken with the country fever, a by no means surprising result of the accumulated cares that had been heaped upon him, in addition to those belonging strictly to his official position, and after narrowly escaping with his life he took a sick leave and returned to France for a change of air, nursing, and rest, calling upon me in New York on his way, his place as Chief Engineer being filled by Mr. Boyer.¹

My acquaintance with Mr. Bunau-Varilla, thus renewed in New York, it has been a great pleasure I think to both of us ever since to cultivate; and I have thereby been qualified to give some particulars about his antecedent as well as subsequent life which is likely to make his name as enduring in American history as that of any other man of foreign birth.

Born in Paris in July, 1859, he graduated as Engineer of the *Corps des Ponts et Chaussées* in 1883; was detailed by the French Government as Engineer *des Ponts et Chaussées* in Tunis and Tripoli from May to September, 1883; again at Bayeux in France from September, 1883, to October, 1884. He was then sent by the Panama Company as Engineer in Chief of one of the three divisions on the Panama Canal from October, 1884, to April, 1885, taking, at this time, command of two of the three divisions of the canal, and in September, 1885, after the departure of Mr. Dingler, the Engineer in Chief of the canal, he was selected, as the fittest man then in the service of the Company, as his successor.

During his absence on sick leave the contractors for the excavations in the Culebra cut failed. As this cut was regarded and still is quite the most serious physical obstacle the Canal Company had to contend with, Mr. Bunau-Varilla, on his return to Panama, was requested to form a new company especially to prosecute that work.

Though the effect of this change was to separate Mr. Bunau-Varilla from the staff in September, 1886, he cheerfully accepted it. Before a year elapsed in his new position the difficulties he encountered from the torrential rains at the Isthmus in getting rid

¹ Mr. Bunau-Varilla's immediate predecessor as Chief Engineer, Mr. Dingler, had himself resigned and returned to France, broken-hearted by the loss of his wife and all his children from the malignant fevers of the country. Bunau-Varilla's successor died of the same disease in the month of April of the same year.

of his excavation by rail were so serious and costly that he became satisfied that some new method must be devised. Taking a hint from the greater cheapness of transportation by water than by land, well known to engineers, he began some experiments in artificial pools or lakes with dredges and tugs. He at length satisfied himself that excavation by a floating dredge, to be towed by a tug where its contents could be discharged promptly and at little expense automatically, would put an end to many of the difficulties to which the previous contractors had succumbed; that there would be no further need of the army of workmen to be constantly changing the rails as the excavation progressed, nor of workmen to watch and adjust the track, which could be neither firmly placed nor properly ballasted to long endure the use required of them. By this device he apprehended no further serious difficulties in contending with the frequent tropical deluges which cover and bury the rails with the detritus washed in from the walls of the trench; no more of the incessant derailings of cars which the incurable conditions of the soil and climate make inevitable, blocking often for weeks all communication between the points of loading and of discharge, leaving hundreds, if not thousands of men unprofitably idle or employed in repairing wreckage.

While thus experimenting with floating dredges, though still in a small way but encouraged by its success, he conceived the idea in 1887 of a temporary high level lock canal to be later dug by dredges floating on the water supplied by the Chagres River.

His plans were adopted and executed from the beginning of 1888. The financial collapse of the Company however, at the end of 1888, terminated his connection with the work. Had he been permitted to continue in charge of the work, he had counted confidently upon having the first navigable level across the Culebra cut established at the 170-foot level, and to thus open the canal for traffic in 1891.

IV

WHEN, during Mr. McKinley's administration, our Congress seemed determined to pledge the credit of our Government in favor of an Isthmian Canal through Nicaragua, a bill for that purpose having passed the Senate both in January, 1895, and

1898, with only few opposing votes, and with no opposition from the Executive, some prominent gentlemen from Ohio met Mr. Bunau-Varilla by chance at a lunch in Paris at the time of the Exposition, and this disposition of the Washington Government became naturally a topic of conversation. As naturally it led to Mr. Bunau-Varilla's exposure of the folly we were in danger of committing. The merits of every imaginable canalizable pass in Central America had been more exhaustively studied by Mr. Bunau-Varilla for the De Lesseps Company than it had ever been studied before or since, and he had published a book in 1892 on the Panama and Nicaragua canals.

But a few months after this conversation, Mr. Bunau-Varilla received a note from one of the guests at the Paris symposium asking him if he would not come over and address a body of leading engineers and business men, who would be invited to meet him, on the subject of the relative merits of the Nicaragua and Panama routes for a trans-continental canal. Mr. Bunau-Varilla promptly notified the writer of his acceptance of the invitation. In less than a month, in January, 1901, he was heard in Cincinnati by a select audience, invited by the Commercial Club of that city. He was the same evening invited to address an audience, composed exclusively of engineers, on the same subject, at Cincinnati, and then at Cleveland, at the request of intimate friends of Senator Hanna. Subsequently, with brief intermissions, he responded to similar invitations from Philadelphia, Boston, Chicago, and, finally, from the Chamber of Commerce of New York. One of the results of these conferences was that at the following session of Congress the Nicaragua route was almost unanimously abandoned by both houses, for the Panama as the most desirable route. As a consequence of this change of public sentiment in Washington, the Colombian Government coöperated with Mr. Hay most zealously, and directed its diplomatic representative at Washington to negotiate a treaty to that effect, which was formally signed by the official representatives of the two governments.

When it became known at Bogota, however, that we were willing and had actually agreed to pay \$40,000,000 for the property of the French Company, whose charter had but one year more to run, if a debatable prorogation of six years was not enforced, the Colombian Government refused to ratify the treaty. The object of this strange behavior, avowed by members of the Col-

ombian legislature, was to await the expiration of the French charter, refuse to adhere to the prorogation, then confiscate the whole property of the French Company on the Isthmus, and appropriate the \$40,000,000, or perhaps a larger sum, if a larger could be extorted, to their own use. Our Government, so long at least as John Hay was Secretary of State, could be a party to no such iniquity; neither were the people of Panama willing to risk the possible and even probable adoption of the Nicaragua alternative, which had many allies with large pecuniary interests staked upon its adoption. The result was the determination of the people of Panama to sever their political connection with the State of Colombia, and, following our example of 1776, proclaim their independence.

Having been kept by Colombia always impoverished to the last degree, and finding themselves unable to organize any effective defence of their independence if contested, for want of means to pay for weapons and soldiers and ammunition, a committee of three or four of the leading citizens of Panama—one of them the first and present President of the State of Panama—then repaired to the United States, where they had, of course, the best right to expect it, for financial aid. Of course they sought Mr. Bunau-Varilla, who chanced to be then in New York, and with whose previous history in Panama they were familiar and whose service to the canal they appreciated. Knowing full well the aggravating nature of their grievances, he lent them, without hesitation, \$100,000, which he placed to their credit with the banking house of J. P. Morgan & Co. of New York. With that equipment fund the Panamanians were able to put themselves so far in a defensive position that the Colombian Government did not think it prudent to attempt seriously to disturb it. They realized that they had imitated the foolish dog which lost the beef in his mouth in trying to secure what he supposed to be another piece reflected in the water he was crossing.

The people of the United States have always thought it a fine thing, and one which every American minister on being accredited to the Government of France is accustomed to refer to in laudatory terms, that Louis XVI lent us a few millions to maintain our independence in 1776. But King Louis lent his people's money, not his own. Mr. Bunau-Varilla lent his own money and at a far more serious risk.

Under any dynastic government in Europe the conduct of Colombia in refusing to confirm a treaty which she had successfully used every means available in diplomacy to induce a friendly Government to sign, would have been regarded as an ample justification for an appeal to the last argument of kings.

We were thus and still remain indebted to Mr. Bunau-Varilla, not only for rescuing us from the disastrous folly of attempting a waterway through Nicaragua, and for the independence of the State of Panama, but for what is more immediately and specially important to us, for drawing with his own pen the treaty known to history as the Hay-Bunau-Varilla Treaty, which secured to us privileges of incalculable importance for the prosecution of our great national and international enterprise of which the State of Panama is to be the theatre; privileges the value of which at some future day will be more fully realized than they are at present.

V

THE Hay-Bunau-Varilla Treaty with the new Republic of Panama was signed in November, 1903, and ratified February, 1904. The Isthmian Canal Commission, of which Admiral Walker was the first President, was recast and converted into an Executive Committee of Construction, and men ranking as eminent engineers were selected from different States for this Commission. Mr. Wallace was sent to Panama as Chief Engineer. Scarcely a year elapsed however before this Commission was dissolved, their efficiency as canal-diggers having failed to commend itself to the President or to themselves. An entirely new Commission was appointed, and Mr. Shonts, the president of a western railroad, was placed at its head, Mr. Wallace remaining Chief Engineer and becoming a member of the Commission. This was in April, 1905.

In the course of two or three months, Mr. Wallace, failing to accomplish what he had thought easy, resigned, and was publicly abused as a coward by the Secretary of War. Mr. Shonts then recommended the importation of Chinese workmen, and that failing as contrary to law, he recommended the letting out the digging of the canal to contractors, but upon terms which made illusory all advantages of the contract system. Both his recommenda-

tions failing, and the cube of the output in Culebra remaining one third of what he had publicly announced it was to be, he followed Wallace's example at the risk of being similarly stigmatized by Secretary Taft as a coward, and he also resigned. This was in January, 1907. Mr. Stevens, the Chief Engineer under Mr. Shonts, was then appointed to succeed him as President of the Commission. A month had scarcely elapsed before he braved the risk his predecessors had successively incurred, and resigned. It then became necessary for Secretary Taft to find a man who could not resign. He had tried the Navy, but Walker was a retired officer who could only be punished by calling him names. So he took an engineer officer from the Army who could not resign without greater personal sacrifices than army officers can ordinarily afford to make, especially when the code of honor does not require a cabinet minister to accept a challenge from a subaltern.

During these three years none of the several executive officers tarried scarcely long enough at their post to become informed of the number of men they had under pay and where they were severally at work. Of course the function of the Canal Commission seemed smothered in surmise; to be pursuing policies which kept the Government at Washington constantly on the defensive, "continually picking slivers out of their own shins."

Sensible of and deploring the President's embarrassment, Mr. Bunau-Varilla addressed him two letters setting forth what he deemed the errors which his engineers had been making from the outset, and by adherence to which he apprehended that the canal would not be opened for traffic in less than twenty years if a sea level canal was contemplated (as the President had in mind in the beginning of 1905), nor for three times the money which his engineers had estimated it would cost. In these letters he also explained how the canal might have been opened for traffic in four years and at a cost inferior to the original estimates of the canal at eighty-five-foot summit level. These letters were dated: the first, twenty-sixth of September, 1905, and the second, the twenty-ninth of October, 1906.¹ These letters cannot be too carefully conned by

¹ These letters we find at length in a brochure recently published in Paris by M. Bunau-Varilla entitled *Le Déroit de Panama—Documents relatifs à la Solution Parfaite de Probleme de Panama*. Dunod et Pinat, Publishers. The pertinent passages of both these letters will be found in Appendix A and Appendix B.

those who are officially responsible for the millions that are now being spent under what is obviously a pernicious system.

The vital features of what the distinguished French engineer terms the perfect solution of the Panama problem were:—

First. By dredging the contemplated prism of the canal instead of excavating it.

Second. To this end building on each side four locks for reaching the summit through the Culebra cut, the level of the water being not lower than one hundred and thirty feet above the sea.

Third. Constructing two dams, one at Gamboa of steel concrete, and one at Bohio of earth, but very low and narrow. Both these dams are across the Chagres on the Atlantic side of the Isthmus. With these dams to collect sufficient water, not only to navigate the canal but by its power to supply all the electrical energy required for lighting, for driving all the machinery, for dredging and for transporting the excavation, thus making an alliance with natural forces instead of contending with them. All the hard labor to be done practically, after the construction of the first high level lock canal, by electricity, of which the Chagres would furnish an inexhaustible abundance, while the officers and men conducting the dredges, scows, and tugs would be sheltered both from the rain and the sun, exposure to which are the chief perils of the Isthmian climate.

Fourth. No railway track, cars, or locomotives to be required for the removal of much if any of the excavation below the first water levels connected by locks, the highest one being the 130-foot level.

Fifth. By dredging under water little or no regard would need to be paid longer to the question whether the dredger encountered rock, gravel, or mud, science having provided our generation with machinery for dredging rock even cheaper under water than above it.¹

The first Isthmian Canal Commission in its report of 1901 fixed the expense of extracting submerged rocks at about \$4.75 a cubic yard. Mr. Bunau-Varilla directed the President's attention and that of his engineers to a modern process of rendering the rocks dredgeable at a very greatly reduced cost by the Löbnitz system, as

¹ See reports and discussion before the June Conference of 1907 Institution of Civil Engineers—London Transactions of Section II.

it is called,¹ which was invented to meet the exigencies of the Suez Canal some eighteen or twenty years ago. By that system, now quite familiar to the Old World, though apparently unknown to the President's engineers, the rock work was done for the Suez Canal at the rate of fifty cents a cubic metre, or less than one tenth the price at which the engineers estimated the price by its familiar methods. The rock dredging on the Suez Canal cost fully twice what it would cost at Panama or would have cost in Egypt but for the interruptions of the work by the frequent passing of vessels and by the long distances to which the excavations had to be transported. Mr. Hunter, the Engineer in Chief of the Manchester Canal, is reported as announcing in 1905 before the President's Consulting Board of which he was a member, that several hundred thousand cubic yards of rock, harder than any encountered on the Isthmus, were going to be taken out of the Manchester Canal to give it a depth of twenty-nine feet by the Löbnitz method, and that the cost was rated a little less than fifty cents a cubic yard, which is the price of the excavation in the dry. This gentleman since then has published in the "Engineering" of the seventeenth of August, 1906, a note about the actual price of this mode of rendering rock dredgeable under water and removable by dredges. It was, after ten months' experience, eighteen cents a cubic yard. In June, 1907, before the Institution of Civil Engineers in London, Mr. Hunter declared that the average cost after completion of the works had been twelve cents per cubic yard for making the rock dredgeable. If we add ten cents for dredging and transporting, the price does not reach twenty-five cents per cubic yard, say one tenth of the price fixed by our Isthmian Commission in 1906, and one nineteenth of what it admitted in 1907 as the standard price.

These low prices of rock dredging are confirmed by the results in many other large maritime works of the Old World, including those of the empire of Japan which has purchased seven of Löbnitz's rock-dredging plants from 1900 to 1905.

In the process of the investigation before the President's Consulting Board, Mr. Wallace, the first Engineer in Chief of the Panama Canal, testified as follows:

¹ A system by which a column or shaft of steel with a movable point may be made to descend upon the hardest rock and crush it in pieces of the size of a man's hand, when it becomes entirely dredgeable.