

LETTER
OF THE
SECRETARY OF THE NAVY,
COMMUNICATING

In compliance with a resolution of the 19th of March last, a report of Rear-Admiral Charles H. Davis, Superintendent of the Naval Observatory, in relation to the various proposed lines for interoceanic canals and railroads between the waters of the Atlantic and Pacific oceans.

JULY 12, 1866.—Read and referred to the Committee on Post Offices and Post Roads.

JULY 16, 1866.—Ordered to be printed. Motion to print 5,000 additional copies; referred to the Committee on Printing.

JULY 21, 1866.—*Resolved*, That two thousand five hundred extra copies of the report of the Secretary of the Navy on interoceanic railroads and canals, with the accompanying maps, be printed and bound for the use of the Senate.

NAVY DEPARTMENT, July 12, 1866.

SIR: I have the honor to transmit herewith a report of Rear-Admiral Chas. H. Davis, Superintendent of the Naval Observatory, prepared by order of this department, and in pursuance of a resolution of the Senate of the 19th of March last, in relation to the "various proposed lines for interoceanic canals and railroads between the waters of the Atlantic and Pacific oceans."

The report, dated the 11th instant, is accompanied by a series of maps.

Very respectfully, &c.,

GIDEON WELLES,

Secretary of the Navy.

Hon. L. F. S. FOSTER,

President pro tem. of the U. S. Senate.

UNITED STATES NAVAL OBSERVATORY,

Washington, July 11, 1866.

SIR: I have the honor to transmit to the department a report on interoceanic canals and railroads between the waters of the Atlantic and Pacific oceans, in compliance with your order of March 20, 1866.

This report is accompanied by a series of maps.

Respectfully, your obedient servant,

C. H. DAVIS,

Rear-Admiral, Superintendent

Hon. GIDEON WELLES,

Secretary of the Navy, Washington, D. C.

Report of the Superintendent of the United States Naval Observatory, to the Secretary of the Navy, in answer to Senate resolution of 19th March, 1866, on interoceanic canals and railroads between the waters of the Atlantic and Pacific oceans.

The following report is made under the direction of the Hon. Secretary of the Navy, in compliance with a resolution of the Senate of the United States, dated March 19, 1866; which resolution reads as follows:

“*Resolved*, That the Secretary of the Navy furnish, through a report of the Superintendent of the Naval Observatory, the summit levels and distances by survey of the various proposed lines for interoceanic canals and railroads between the waters of the Atlantic and Pacific oceans; as also, their relative merits as practicable lines for the construction of a ship canal, and especially as relates to Honduras, Tehuantepec, Nicaragua, Panama, and Atrato lines; and also, whether, in the opinion of the Superintendent, the Isthmus of Darien has been satisfactorily explored; and if so, furnish in detail, charts, plans, lines of levels, and all information connected therewith, and upon what authority they are based.”

The object of this inquiry is to collect and collate our existing information concerning the several isthmuses through or over which it has been proposed to open a communication between the Atlantic and Pacific oceans. It is the aim of the honorable senator, Mr. Conness, of California, to acquire by the answer to his resolution such accurate knowledge with regard to the whole question as will, in the first place, prevent the re-examination of any ground which is already sufficiently known; and in the second place, will prevent any useless expenditure of money upon schemes that are infeasible or unpromising.

The resolution is properly divided into two general heads, which are again subdivided as follows:

I. The consideration of the “various proposed lines” will include,

“Summit levels;”

“Distances by survey;” and

“Their relative merits as practicable lines for the construction of a ship canal, especially for the Honduras, Tehuantepec, Nicaragua, Panama, and Atrato routes.”

II. The inquiry, “has the Isthmus of Darien been satisfactorily explored,” calls for—

“Charts;”

“Plans;”

“Lines of levels, and information therewith;” and

“Authorities on the whole subject.”

In conference with the mover of the resolution I have ascertained that I shall execute the task assigned me in the most acceptable manner if I confine myself to a simple statement of facts, avoiding all unnecessary descriptions, whether of geography, topography, or natural history, all scientific details not required for a full comprehension of results, and all merely speculative opinions.

In truth, nothing would seem to be less called for at the present day than a renewed attempt to show by argument, whether based on statistical or other considerations, the advantages of a suitable artificial water communication between the two great oceans. This project has engaged the attention of the most eminent statesmen, political economists, engineers, and merchants of the world, from a period but little subsequent to the discovery of this continent. Minds of the largest comprehension have employed themselves in the contemplation of the benefits that would flow to mankind from the successful accomplishment of this purpose.

By promoting intercourse, and therefore peace and good will among men, it would contribute as much to human progress as any of the leading discoveries

of the century. It is entitled to this highest commendation, that it will elevate the authors of its execution to the rank of those in history who have deserved most of their fellow-men.

The ingenious and enterprising thinkers of this country and of western Europe will never rest satisfied until this project is either carried out or is shown by a thorough examination, such as leaves no question unanswered, to be totally impracticable. I will so far anticipate the conclusions of this report as to say that my study of the subject rejects the latter idea.

With these preliminary remarks I will enter at once upon the business of the report under the several divisions and subdivisions heretofore enumerated :

I. The various proposed lines for interoceanic canals and railroads and their relative merits, viz :

- A, Tehuantepec;
- B, Honduras;
- C, Nicaragua;
- D, Panama;
- E, Atrato.

A.—TEHUANTEPEC.

The attention of the early discoverers was drawn towards this isthmus by two of its features—one, the remarkable depression of the Mexican plain at this point, and the other, the hydrographic basin of the Coatzacoalcos, which drains the northern slope of the sunken Cordillera and discharges itself into the Gulf of Mexico.

Mr. Williams, who is our best authority with regard to this part of the continent, divides the Isthmus of Tehuantepec into three distinct divisions, each possessing its own characteristic peculiarities. The first, or northern division, lying between the Cordilleras and the Gulf, he calls the Atlantic plains; the second, or middle division, the mountainous district; and the third, or southern division, bordering on the Gulf of Tehuantepec, he calls the Pacific plains.

In the series of maps appended to this report (No. II,) I have copied his two profiles, one of which extends from ocean to ocean, while the other comprises the mountainous districts only. These maps contain in themselves all the details necessary to a correct understanding of the ground. They were prepared, it will be remembered, with reference to a railroad project only. But for many years the idea had been entertained of opening a canal between the two oceans; and this idea received a sudden impulse in 1771, from the unexpected discovery in the port of San Juan de Ulloa that some cannon cast at Manilla had crossed the isthmus by the rivers Chimalapa and Coatzacoalcos. (Humboldt—*Essai Politique.*)

This discovery led to the most extravagant expectations, and gave rise to a succession of surveys or examinations under the governments of the Viceroyalty and of the Republic, which surveys are of little value at the present time. The really accurate and reliable survey of the isthmus was made by the scientific commission under the direction of Major (now Major General) J. G. Barnard, United States engineers, in 1850-'51, and it is this which has furnished us with our profiles. From this survey we learn that this route possesses but little "merit as a practicable line for the construction of a ship canal."

B.—HONDURAS.

Our knowledge of this isthmus is derived from hydrographic, topographic, and barometrical surveys, instituted by the Directors of the British Honduras Interoceanic Railway Company, and reported by the general agent of the company, E. G. Squier, Esq., August 1, 1858.

Since it has never been proposed to construct a canal on this route, it will not be necessary to speak of it at length. The third of the appended maps is both a map and profile of the whole line between the bay of Honduras and

the bay of Fonseca. The reader who follows the course of the surveyors, naturalists, and geologists from the capacious, safe, and excellent harbor of Puerto Caballos (Port Cortes) through regions remarkable for their salubrity, fertility, great variety of climate and productions, and valuable mineral resources, to the waters of the splendid harbor of La Union, cannot but regret that capitalists have not found it to their interest to carry out one of the most promising, and one of the least embarrassing, enterprises of the day.

But, so far as concerns its relative "merit as a practicable line for the construction of a ship canal," Honduras is excluded from our further consideration.

C.—NICARAGUA.

There has been a time when the transit from ocean to ocean, on a line following the river San Juan del Norte, either in its bed or on its banks, crossing Lake Nicaragua, and thence to the Pacific, has enjoyed special favor and attention. From Greytown to the lake the mode of proceeding has been the same in most of the plans. It has included the improvement of the navigation of the river San Juan, where possible, by excavations in its bed, and by the construction of dams, which, with the rapids of the river, were to be passed by means of locks and canals. But, from the lake to the Pacific outlet, various branches have been proposed. Three of these pass through Lake Managua; a fourth terminates at Brito; a fifth, at San Juan del Sur; a sixth proceeds by the Sapoa river to Salinas bay; a seventh, keeping in the southern part of the State of Nicaragua, proposes to cut from the river San Juan, through the State of Costa Rica, to Nieoya gulf. Only two of these routes have been carefully surveyed, those terminating in Brito and San Juan del Sur.

There are so many difficulties attending all these routes, which detract from their "relative merits as practicable lines for a ship canal," that I should feel authorized, under ordinary circumstances, to pass over this region in a few words; but so much has been said and written about it by eminent authorities that I feel called upon to present some descriptive details.

A variety of circumstances have concurred to concentrate public opinion and favor upon this route. I refer particularly to the accidental settlement of Greytown; to the establishment of a transit through Nicaragua; the actual navigation of the San Juan river, and of Lake Nicaragua; the connexion of eminent names, including that of the present French Emperor; and the agricultural and mineral wealth of the Chontales region. And to these circumstances may be added the advances seemingly made by nature in offering the water communications of San Juan and the lakes, which reduce the isthmus to one-tenth of its whole breadth. Extravagant expectations have been fostered, and hasty schemes have been formed, including extensive plans of colonization—schemes that never have reached maturity.

The late Admiral Fitz Roy, in the first paper which he presented to the Royal Geographical Society, on the isthmus of America, entered into a careful examination of this line and its branches, and maturely considered the value of the statements made by its advocates, and the feasibility of the project with reference to the natural difficulties to be overcome. The conclusion at which he arrived was unfavorable.

I take pains to cite the authority of this distinguished hydrographer, because it will be received with the highest respect by all who are acquainted with his useful labors and great abilities. It is not worth while to follow him over the same ground; to discuss the statements of Mr. Bailey, or the data of the French Emperor, or to dwell upon the unfavorable conditions arising from climate, earthquakes, volcanoes, &c. I will base what I have to say upon the report of the survey made by Messrs. Childs and Fay, in the years 1850-'51, for the American Atlantic and Pacific Ship-Canal Company.

The map appended to this report, numbered IV, contains a profile of the line surveyed; and this profile may be regarded as a type of the whole region, em-

bracing all the branch lines mentioned above. It is not at all probable that any other of the proposed routes would find either a lower summit level or easier cuts.

The line selected by Col. Childs proceeds from Lake Nicaragua by a short and easy route to the harbor of Brito. It traverses the lake directly to its outlet at Port San Carlos; it employs slack-water navigation on the San Juan river for a distance exceeding ninety miles, and then pursues a canal, independent of the river, to the harbor of San Juan del Norte. This plan of operation requires fourteen (14) locks to descend from the lake to the Pacific ocean, and fourteen (14) locks to descend from the lake to the Caribbean sea, in which last enumeration are included light locks at dams on the San Juan. There are seven (7) dams on the river. Costly improvements, possessing the character of artificial harbors, will be necessary at the two points of departure from the lake. The seaports of Greytown and Brito, at the two ends of the line, will require costly and extensive improvements in the way of excavations, piers, jetties, breakwaters, &c. The total length of the line is a little more than one hundred and ninety-four (194) miles. It may be safely asserted that no enterprise, presenting such formidable difficulties, will ever be undertaken with even our present knowledge of the American isthmuses. Still less is it likely to be entered upon while such strong and well-founded hopes are entertained by the promoters of the union of the Atlantic and Pacific oceans of finding elsewhere a very much easier, cheaper, and more practicable route for a canal, in every way suited to the present demands of commerce and navigation. The relative merits of the Nicaragua route as "a practicable line for the construction of a ship-canal" do not require further consideration.

I have taken Childs's survey as a standard. I will therefore mention that it is regarded by Squier and other competent authorities as the authentic and reliable survey of the Nicaragua route; and, further, that in March, 1852, his drawings, reports, and estimates were submitted to the examination of Colonels Abert and Turnbull, United States engineers. Squier's language in regard to the survey is very emphatic; he says, "Childs's survey is the only one to be accepted as conforming to modern engineering requirements." Childs's report was further submitted by the Earl of Malmesbury to English engineers, who also questioned its author personally. They reported that, "presuming Colonel Childs's data and statements to be correct, the harbor of Brito is, in size and shape, unworthy of this great ship navigation."

CHIRIQUI.

The next line in the order of our enumeration is Panama; but there lies between Nicaragua and Panama another isthmus which has been thought of more than once as a convenient place of transit—the Isthmus of Chiriqui.

The best information concerning this route is derived from the examination made by the Chiriqui commission, commanded by Commodore Frederick Engle, United States Navy, of which Commander Jeffers was the hydrographic engineer, and First Lieutenant J. St. Clair Morton, who fell at Petersburg, the topographical engineer. Commodore Engle describes the harbor of Chiriqui as "large, deep, and well protected." Commander Jeffers confirms the accuracy of the survey of Captain (now Rear-Admiral) Barnett, Royal Navy, and adds: "No finer harbors can be found than those on the Atlantic side, Shepherd's harbor included." He says also of Golfito, in Golfo Dulce, on the Pacific side, that it "is unsurpassed in natural facilities; * * * three streams, the Golfito, Coisal, and the Canaza enter the harbor and afford an ample supply of fresh water." Lieutenant Morton landed at Frenchman's creek, and crossed the isthmus twice; in doing which he explored a swamp of great extent, and discovered a hitherto unknown pass through the Cordilleras. His examination resulted in "the conviction that it is entirely practicable to connect the harbors by a line of railroad adapted to commercial purposes." But since Lieutenant Morton describes his

work as a reconnaissance merely, made with the Schmalealder compass, and has left no map, journal, or note-book in the archives of the War Department, I am unable to trace his route precisely, and have accordingly laid it down on the general map with a broken line.

Mr. Evans, the geologist of the Chiriqui commission, made examinations to ascertain the extent and value of the coal deposits on the Chiriqui lands. He found "coal seams varying in quality from lignites to semi-bituminous and semi-anthracite coals." * * "The supply is abundant." He found "gold and ores of iron, copper, and platinum, * * a rich mineral region." The plains are described as being fertile, and abounding in timber. Concerning a portion of the province of Chiriqui, known as the territory of Burica, we have some interesting information from J. H. Smith, esq., of Panama, a Fellow of the Royal Geographical Society. I have cited him among my authorities for the convenience of the future student or explorer, when this region is again brought under examination.

D.—PANAMA.

There is no part of the American isthmus with which we are so well acquainted as the old route from Porto Bello or Chagres to old or new Panama, the established line of communication since the year 1532—that is, since twenty-three years after the first settlement in America. The surveys made by the engineers of the Panama railroad have established the important fact that the difference between the mean level of the two oceans is either nothing, or so slight as to present no obstacle to the construction of a canal. The difficulties pertain altogether to the climate, to the elevation, the nature of the soil, and the supply of water. The character and extent of these difficulties may be learned from the survey and project of M. Garella, Ingénieur en chef des Mines, in 1843. In order to present the whole subject in the most satisfactory manner, I have included among the maps appended to this report, (No. V,) M. Garella's survey and profiles containing all the details of his project.

This route was selected only after a careful inspection of the intervening space, and after making the requisite levelings. It will be seen by this map that he follows the valleys of the Bernardino and Caimito on the southern descent, and those of Quebrado and Chagres on the northern. The mountainous region approaches very near the Pacific, and its highest elevation is four hundred and fifty-nine (459) feet above the level of the sea. He tunnels the mountain at about ninety-nine (99) metres (324 feet 9 inches) below its highest point; and he establishes his summit-level for a distance of 25,361 feet, at an elevation of one hundred and thirty-five (135) feet above high water from the Pacific ocean. From this summit-level he descends to the Pacific ocean by means of seventeen (17) locks, some of which are necessarily very much crowded. On the other side he descends to the Atlantic by eighteen (18) locks, which, owing to the more gradual descent on the north, are more conveniently spaced.

It is remarked by the Commission of the "Ponts et Chaussées," appointed to report upon M. Garella's project, that his mode of proceeding is reasonable, and entirely in conformity with the rules of art.

A glance at the plan and profile shows that the near approach of the chain of the Andes to the Pacific ocean obliges him to pursue the course he has adopted. Of the whole length of the summit-level, seventeen thousand five hundred and fifty feet are subterranean; and, as the Commission observes, this is not only inconvenient to vessels, but it involves great expense, since the tunnel must be sufficiently high to allow vessels to pass through with their lower masts, at least, standing.

The means of feeding the canal are not satisfactorily stated. The river Chagres was gauged, it is true, at Cruces and at Gorgona, but the river is to be tapped above these points. Provision is also made for an auxiliary reservoir; still, the Commission is not satisfied on this question.

The harbors which form the termini of the canal are, on the Atlantic side, Navy bay, and, on the Pacific side, the bay of Vaca del Monte. We know that Navy bay is an insecure anchorage at certain periods of the year, and the harbor on the Pacific is altogether insufficient for vessels of even moderate draught. M. Garella is obliged to include in his estimates a sum of a million and a quarter of dollars for the improvement of this harbor. I have entered into these details of M. Garella's project—all of which are more fully displayed on the map—because it presents a fair representation of the difficulties to be overcome in the construction of a navigable ship canal across the Isthmus of Panama proper; and in order to render this subject still more intelligible to the general reader, I have added Colonel Hughes's survey of the Panama railroad in map No. VI, which contains the topographical features and profile of the route.

I have spoken of the Isthmus of Panama proper. Geographers have given the name of Darien to that part of the isthmus which is contained between the Panama line and the province of Choco. On this Isthmus of Darien, as we shall call it, between the Panama line and the province of Choco, there are three other lines or places which have always commanded great interest, but which have never received the attention they merit. These three routes are from the Chepo or Bayanos river to San Blas or Mandinga* bay, from the Gulf of San Miguel to Caledonia bay, and from the Gulf of San Miguel to the southern part of the Gulf of Urabá or Darien, or else to some point on the lower part of the Atrato below the mouth of the Caerica. I will take up these three in the order now mentioned.

The first of these lines, from Chepo to San Blas, has always been the subject of special curiosity on account of the jealous exclusion by the Indians of all strangers from their territory. Our accurate knowledge of the geography of the coasts on both sides enables us to determine that here is the narrowest part of the isthmus. This is of itself an important fact; and added to this, a rumor or report has been received from the Indians in this vicinity that they are in the habit of hauling their canoes on wooden slides across the Cordilleras from the Mandinga river and launching them in the waters of the Bayanos. This rumor, which is noticed by many writers, is particularly mentioned by Mr. Oliphant, the secretary of the Royal Geographical Society, in a paper read before that society on the 24th of April, 1865. The writer of that paper made a journey from Panama to the Chepo or Bayanos river simply for a reconnaissance, and he says that the tide of the Pacific extends to within fifteen (15) miles of the northern coast, and that he saw from Chepo a remarkable depression in the mountain chain about ten miles distant. He makes the remark, in which all will concur, that it is a discredit to the civilization of the nineteenth century that this part of the isthmus should not have been explored. This is not owing, however, to a want of effort. Attempts to cross the isthmus at this point were made by Mr. Hopkins and Mr. Wheelwright. They were both driven back by the aborigines.

It is very gratifying to have it in my power to say that this discredit to the civilization of the nineteenth century has been removed by the indefatigable zeal and enterprise of Mr. Frederick M. Kelley, of New York, of whom it was justly said by the President of the Institution of Civil Engineers of London, that he "had produced more intelligible information towards the solution of this problem, of such vast importance to the commercial and political interests of the world, than had hitherto been given;" and of whom Sir R. Murchison, Vice-president of the Royal Geographical Society, also said that he "heartily wished he might succeed in this great and philanthropic project, which so deeply interested all civilized nations." After having spent a great deal of labor and money upon the examination of the Atrato and San Juan rivers in search of a suitable route for an interoceanic canal across the province of Choco, Mr. Kelley and his friends, in 1864, took up the long deferred but much coveted exploration of the

* Also called Gulf of Manzanilla.

route from the Chepo to the Gulf of San Blas. The results of this exploration are given in the annexed map, numbered VII.

From Mr. Kelley's plans it will be perceived that the whole length of the route from ocean to ocean is only thirty miles. On the north, there is the admirable, spacious, and deep harbor of San Blas; and on the south the channel leading into the bay of Panama has not less than eighteen (18) feet of water at mean low tide, while the ordinary rise of tide is sixteen (16) feet. I give these figures from Mr. Kelley's survey; but I must observe that this result of the examination by his engineer of the entrance of the Chepo is entirely unexpected, and does not accord with the Admiralty charts. But the most striking feature of the project, as of M. Garella's, is a tunnel, similar in its length, and in other respects, to the great tunnel through the Alps at Mont Cenis, which is nearly one-half cut through, and in which the progress is so satisfactory that the period of its completion can be definitely fixed.

When the tunnel through Mont Cenis, and the still greater one through Mont St. Gothard, are finished and in use, such undertakings will cease to be regarded with the aversion we now feel towards them.

It must be observed, however, with regard to Mr. Kelley's survey, that owing to its being a private affair it was necessarily accomplished at the least expense and with the utmost expedition. It pursued a single line, without deviating to the right or left, although the surveyors were satisfied that they saw evidences of greater depression to the westward of their course; and there can be no doubt whatever that a deliberate examination, made under such advantages as would pertain to a Governmental survey, would lessen the difficulties, and, perhaps, lead to the discovery of such a route through the valleys as would render a resort to tunneling unnecessary. This subject will be resumed in the general remarks and recommendations with which the report will be concluded.

GULF OF SAN MIGUEL TO CALEDONIA BAY.

The next place in order is the line between the Gulf of San Miguel and Caledonia bay. We have here, at both ends of the line, harbors spacious and admirable in every respect, and, on the south side, there is a height of tide suited to the construction of docks for repairs, &c. It is held by many persons that no line of interoceanic canal merits serious attention unless it possesses this indispensable requisite of good natural harbors, requiring no artificial improvements, except those for the ordinary conveniences of commerce, such as wharves and docks. Certainly it will add very much to the difficulties and embarrassments, as well as to the expense of this great enterprise, to mix with it any doubtful questions of harbor improvement.

The greatest interest has always centred in this particular line on other accounts. The first settlement in all America was in this vicinity, and the next settlement on the isthmus was at Agla, a few miles inland, on Caledonia bay. It was through this district of country that the Buccaneers made frequent incursions upon the original Spanish settlers, who had opened and were working mines at Cona or Cana and Espiritu Santo. The history of the Buccaneers furnishes us with many interesting accounts of their incursions into this region. But since their topographical descriptions are not full enough to be traced on any modern map, it is sufficient merely to refer to them.* It was, no doubt, owing to the success of the Buccaneers that Paterson was induced to settle at Darien with his Scotch colony. He derived the information on which he acted, in part, from personal intercourse with the surviving Buccaneers. In one of his letters to the Court of Directors of the "Indian and African Company," cited

* It may be said, on the authority of Fitz Roy that they can be followed on the old Spanish maps.

by Dalrymple in his *Memoirs of Great Britain*, vol. 2, page 115, he says: "Gold may be gotten in very many places. No mines are worked or looked after that yield as low as $\frac{1}{2}$ oz. per day to the laborer. Often they yield 4 oz. per day. The mine of Cana is worked by a thousand negroes."

In our own time, this line of communication has received more attention than any other, except the Panama line. The governments of Great Britain, France, and the United States have each undertaken its exploration with a singular want of success. One English surveyor, Mr. Gisborne, entered the country from Caledonia bay, and, after reaching the summit of the Cordillera, turned back. Captain Prevost, of the royal navy, led the exploring party which ascended the Savana from the Gulf of San Miguel to the head of navigation, and thence cut his way through the woods and swamps until he reached the Cordillera, when he also turned back. He says in the official report of his proceedings, under date of January 4, 1854, "Although finding ourselves in the centre of the Cordilleras, and, I believe, within a very few miles of the object of our search, yet, having already exceeded the limits of my stay, it became my duty to rejoin the ship without delay, still feeling confident that had time and our provisions allowed us, we should eventually have reached the Atlantic shores, and that easily, by following one of the several rivers or streams which appear to exist in this range of hills, forming certain passages to the sea."

The expedition of Strain, though it called out a remarkable display of courage and endurance under the most fearful trials, was even less fruitful of knowledge than those of Gisborne and Prevost.

I have appended a map, numbered VIII, of the joint exploration of the two English gentlemen here mentioned, taken from Gisborne's report to the Royal Geographical Society. It will be perceived that the routes of these two gentlemen join on to each other. Sections of both tracks are given on the map.

The only person in our time who claims to have crossed the isthmus directly between the two great bays is Dr. Cullen. Dr. Cullen says that on his first journey into Darien, in 1849, he was totally ignorant of the existence of the Savana river until he actually saw it, after entering Boca Chica, "when," he continues, "finding the great depth of water at its mouth, and that it flowed almost directly from the north, I became convinced that I had at last found the object of my search, viz., a feasible route to the Atlantic; and thereupon I immediately ascended it, and crossed from Cañasas to the sea-shore, at Port Escocés, and back; and subsequently, in 1850, and also 1851, crossed and recrossed at several times and by several tracks the route from Savana to Port Escocés and Caledonia bay, notching the barks of the trees as I went along with a *machete* or cutlass, always alone and unaided, and always in the season of the heaviest rains. * * * And I had not the least hesitation in deciding that that must be the future route for interoceanic communication for ships." (*Isthmus of Darien Ship Canal*, by Dr. Cullen, 2d edition, p. 19.)

The principal point of interest in this exploration is, of course, the passage of the Cordillera. Concerning this, Dr. Cullen says: "From the sea-shore, (Port Escocés,) a plain extends for nearly two miles to the base of a ridge of hills, which runs parallel to the coast, and whose highest summit is about 350 feet. This ridge is not quite continuous and unbroken, but is divided by transverse valleys, through which the Aglaseniqua, Aglatomate, and other rivers, have their course, and whose highest elevations do not exceed 150 feet. The base of this ridge is only two miles in width, and from its south side a level plain extends for thirteen miles to a point on the river Savana, called Cañasas, which is about twenty miles above its mouth." (Page 28, *ibid.*)

No language could be more simple, explicit, and direct than the language of this statement. Admitting it to be literally correct, we have to go no further, for the object of our search, the existence of a practicable route for an interoceanic ship canal, has been discovered.

Dr. Cullen's map, numbered IX, of the series appended to this report, presents a line of communication which combines all the advantages required by the engineer. It possesses the indispensable requisite of harbors of perfect security, sufficient depth of water, and large capacity at both termini—that on the Pacific side having a rise of tide which adapts it to the construction of building and repairing docks, a circumstance the value of which cannot be over-estimated. It cuts the Cordilleras at a depression at least thirty feet below any that has ever been reported, and several hundred feet below any that has actually been surveyed, or that has been approximately determined by trustworthy observers. The course of this line is direct, free from obstructions, and exceptionally healthy, while its outlets open upon coasts where violent storms are rarely known. The plains on each side of the dividing ridge are of easy slope and readily penetrated. The Savana river itself would form a part of the canal. And, finally, accepting the particular statement of Dr. Cullen as fully reliable, a ship canal may be cut on this line without locks, and even without tunnel, and yet not surpass either in difficulty, in labor, or in the amount of time or money consumed in its construction, several other monuments of human genius and enterprise in past times and in our own day.

Thus, for example, the Mexican Desague, of which Humboldt says, "in its actual state it is undoubtedly one of the most gigantic hydraulic operations ever executed by man. We are filled with admiration when we consider the nature of the ground, and the enormous breadth, depth, and length of the aperture. If the cut were filled with water to the depth of ten metres (32.8 feet) the largest vessels-of-war could pass through the range of mountains which bound the plains of Mexico to the northeast." (Humboldt, *New Spain*, vol. 2d, pp. 110, 111.) "This wonderful work," says Admiral Fitz Roy, "200 feet deep and 300 feet wide for nearly a thousand yards, and above 100 feet deep, through an extent of three thousand yards, (making altogether two miles of distance, in which that vast excavation would be capable of concealing the masthead of a first-rate man-of-war,) executed within the last three centuries within Central America, should induce us to listen respectfully to the plans of modern engineers, however startling they may appear at first." (*Journal Royal Geographical Society*, vol. 20, p. 176.)

A ship canal twenty-six or twenty-seven miles in length, on such a line as that described by Dr. Cullen, (pp. 24, *et seq.*) with a cut of two miles only through hard rock, would, in all respects of time, money, and difficulty, fall far short of that tunnel which is now in progress under the Alps at Mont Cenis, for the purpose of connecting France and Italy by a continuous railway. The length of this tunnel is seven miles and 1,044 yards. At Mont Cenis it is, in section, twenty-six feet three inches and twenty feet eight inches high above the rails. Throughout the whole line it passes through rock, and, in some places, very hard rock. This by far the greatest and boldest work of the kind ever yet undertaken, with its covered drain throughout, its lining of masonry, its recesses at the distance of every fifty metres, (164 feet,) and its chambers ten or twelve feet square at intervals of 1,650 feet, may well spur us on to engage in this enterprise, which has for its object the union not of two adjacent countries, but of remote continents; the promotion, not of interior traffic in one or two districts, but of commerce and intercourse between all the peoples of the habitable globe. I say this because the construction of an interoceanic ship canal is—to borrow the thought of an eloquent writer on this subject—the same thing as if by some revolution of our globe the eastern shores of Asia and the southern continent were brought nearer to us.

Such are the prospects which the statements of Dr. Cullen offer to us. But it is with extreme reluctance I am compelled to say that these statements stand in Dr. Cullen's book as mere assertions, unaccompanied by notes or measure-

ments. I cannot but join with Admiral Fitz Roy in his regret that Dr. Cullen has not given to the world the journals and details of his repeated explorations; such, for example, as are given by Gisborne and Prevost on or about the same line. However, it is a great satisfaction to observe that Admiral Fitz Roy gives Dr. Cullen credit for "valuable information gleaned from archives, maps, books, oral accounts, and his own personal observation, and for being the first to ascertain the existence of a low summit-level." He adds that Dr. Cullen's statement "is corroborated by Gisborne;" and ascribes to Dr. Cullen the merit "of recommending from personal observation the river Savana as preferable to the Chuquanaque on account of its nearer approach to the north coast."

It is also gratifying to perceive that Airiau, who has made a careful study of this subject, has arrived at the same conclusion; that is, that the proper line for an interoceanic canal is from the bay of San Miguel up the river Savana to its junction with the Lara, and from this point straight across the plain to the foot of the Cordilleras. (Prevost's route, approximately.) "With regard to the Cordillera, in proportion as it advances, proceeding from the base of the isthmus, it descends a good deal, and is only, so to speak, a range of hills or isolated peaks, the bases of which are intersected by ravines which point out to the engineer the true route of the canal. The Indians in the neighborhood of Caledonia bay make use of these passages. One of them is elevated about fifty metres, (164 feet,) and is covered with a luxuriant growth of mahogany, palm, ebony, and other trees." (Canal Interoceanique par l'Isthme du Darien, p. 52. See list of authorities appended to this report.)

The same writer describes the country on the north of the Cordillera as a slope, gradually descending to the water's edge. No special authority is given for this description of the Cordillera, though Gisborne and other travellers are generally quoted; and it is further to be remarked that Airiau's estimates (chap. iv) are based upon probabilities, not on actual measurement, and these probabilities are deduced from Garella's survey, as well as from the statements of Gisborne and others.

Besides Cullen and Airiau, there are other high authorities who have regarded the Isthmus of Darien as the place where we are to look for the consummation of our wishes. Admiral Fitz Roy, who, at the period when he last wrote, 1853, had made a more careful and accurate study of the whole subject than any man then living, and whose opinions no one experienced in the hydrography of the globe will lightly question, has said: "A strong conviction remains on all our minds that Darien should be surveyed without delay. The illustrious Humboldt declares himself thoroughly satisfied that the Isthmus of Darien is superior to any other portion of the entire neck for a canal."

But we can go further back in our authorities. The incursions of the old Buccaneers, Dampier, Ringrose, Sharp, Wafer, and Davis, which can be followed on the old Spanish maps, have made us strangely familiar with some parts of this region, abounding in the gold that was the object of their search. The well-known and productive mines of Cona and Espiritu Santo, partly on account of these very incursions, were long since abandoned. We also follow, without difficulty, the direct route (1788) of the Spanish officer, Don Manuel de Milla Santa Ella, from Caledonia harbor to El Principe, thence down the Savana river to the harbor of Darien, up the Tuyra, and again up the Chuquanaque to the sources of its upper tributaries, whence he crossed to his station at Caledonia bay. (Cullen, pp. 192 *et seq.*)

And, lastly, we must adduce the testimony of that very remarkable man, William Paterson, who carried with him in his settlement at Caledonia harbor, ample stores of information collected from the Buccaneers, who, during his long residence, had leisure and opportunity to make himself acquainted with the surrounding district, and who made at least one journey into the interior, the journal of which is given in his papers. One hundred and seventy years ago, the far-

reaching mind of Paterson had contemplated the Isthmus of Darien with the same enlightened views as the statesmen and political economists of the present time. He originated and partly executed the project of settling a great colony in this then remote region for the purpose of "removing distances and drawing nations nearer to each other." In one of his letters to the Darien company, he says, (what is as true now as it was then,) "the time and expense of navigation to China, Japan, the Spice islands, and the greater part of the East Indies, will be lessened more than one-half, and the consumption of European commodities and manufactures will soon be more than doubled. * * * Thus this door of the seas and key of the universe, with anything of a reasonable management, will, of course, enable its proprietors to give laws to both oceans and become arbitrators of the commercial world."

This, however, is not said in any narrow spirit of selfishness; for, he adds, "You may easily perceive that the nature of these discoveries are such as are not to be engrossed by any one nation or people to the exclusion of others." And he denounced the contrary policy as being no less ruinous than niggardly.

I might extend these and similar quotations almost indefinitely. A glance at the list of authorities on this subject of interoceanic communication, appended to this report, will suffice to show how easy it would be to so stretch out this paper to any extent by historical, geographical, hydrographical, statistical, and descriptive passages and illustrations. I am, however, free from any temptation to do so, for I am well aware that I shall best answer the end of the call under which I am writing by confining myself as strictly as possible to the actual state of our knowledge of the great isthmuses, and to the channels into which new attempts are to be directed. But I will not forbear to mention that it is interesting to the American statesman of the present day to see in what light the possession of the isthmus was regarded by a British statesman of the latter part of the last century. (*Vide Dalrymple's Memoirs*, vol. 2, p. 111.)

I have still one more exploration in this region to mention, the last one of which we have any accurate knowledge, but by no means the least interesting and profitable. I refer to the expedition of M. Bourdiol, civil engineer, who was employed in 1864, by a French society, to conduct a new exploration on the Isthmus of Darien. For the greater convenience of supplies for his party, he found it expedient to begin on the Pacific side. His expedition comprised twenty-five persons, of whom one was an Indian and nine were negroes. M. Bourdiol's course lay from the mouth of the Lara across the isthmus to the river Chuquanaque, which he reached at a point a little below the Sucubti. Here he was obliged to turn back, all the natives having abandoned him through fear of the hostile aborigines (the *bravos*) on the northern slope of the Cordilleras. This expedition of M. Bourdiol is full of instruction for the future surveyors of the isthmus, not only on account of the manner in which it was conducted, but on account of its failure to reach the Atlantic shore. M. Bourdiol had made better preparation than any of his predecessors. He introduced into his work accuracy, zeal, and laborious industry. He encountered great hardships, and yielded only when the obstacles to his progress became insurmountable.

His narrative in the Bulletin of the Geographical Society of Paris, 1864, will be attentively read by every one who is to follow in his track. But the principal lessons to be derived from it may be summed up as follows:

First. The imperative necessity of taking provision in a concentrated form, on which I dwell more than once in this report, is very clearly shown. The want of provisions was one of the insurmountable obstacles that obliged him to turn back. It appears to have been impracticable to supply the party from the vessel when they had reached the interior.

The second and equally important lesson is, that the proper season is to be selected. Bourdiol attempted to make his exploration in the month of May. At one time he was in danger of having his retreat cut off by the enlargement

of the streams, and by the torrents created by the abundant rains. At another time he was wading up to his waist in water; and, in order to make sure of a safe return across an inundated plain, he left, as he advanced, his people stationed at intervals like live beacons. But for this precaution he might never have found his way back; and, in spite of it, he came near losing one of his men.

Thirdly. I speak elsewhere of the necessity of providing the means of clearing the way through the dense and matted undergrowth by steel and by fire. (Pages 18-19.) M. Bourdiol's experience on this point is exceedingly instructive. The natives may be employed with their *machetes*. They are strong, active, and enduring, but they are very timid, and not to be relied upon.

Fourth and lastly. Suitable preparation must be made for encountering the hostility of the Indian *bravos* who inhabit the Atlantic declivity.

This is the proper place to call special attention to the benefits which have been conferred upon the world by all previous explorers, whether their labors have been carried on systematically and to an end, or have been cut short by accident, hostility, or a want of proper equipment.

Every successful and complete survey, like those of Tehuantepec, Honduras, Nicaragua, Panama, &c., which has proved the unfitness of the route for an interoceanic communication by canal, has benefited us by eliminating these points from our consideration, and thus narrowing down our field of inquiry. Every unsuccessful attempt has conferred a benefit by teaching us the precautions we are to observe, and the errors we should avoid.

FROM SAN MIGUEL TO GULF OF URABÁ OR DARIEN.

The remaining line on this part of the isthmus is that which ascends the Tuyra and crosses to the valley of the Atrato. It is satisfactory to know that a plan for a survey of this route is already on foot. Mr. Gogorza, a resident of New Granada, has recently communicated the discovery of a short and easy transit across the Cordillera at this point. According to his statement, the mountain is depressed to an elevation of fifty-eight metres (190 feet) above the level of tide-water; the distance between the waters, navigable by canoe, on the two sides of the mountain is only three miles.

Since the verification of these estimates is about to be undertaken by competent authority, it is not expedient to say anything further on this route than this: that it is expressly pointed out by Fitz Roy, and drawn on his general map, and that it is also mentioned at length by Trautwine. A regular survey by the Government would be desirable, whether the present private enterprise on foot should make any important discoveries or not.

E.—THE ATRATO ROUTE.

For many years explorations have, from time to time, been carried through the valley of the Atrato to various points on the Pacific coast in search of a suitable path for effecting a union of the two oceans by a ship canal without locks. These explorations have, in one respect, been satisfactory. They have been conducted by able engineers who enjoyed the confidence of the public, and they have been given to the world in the most useful and intelligible form. We are now sure that we are well acquainted with the region, especially in those particular parts over which the surveyors have passed. Whoever will take the pains to study the maps and reports of Trautwine, Kennish, and Colonel Michler of the United States engineers, will be able to form an independent opinion with regard to the practicability of finding in this direction the means of fulfilling the world's expectation of a passage through the great American isthmus. It is well known that we are indebted to one gentleman, principally, for all these trustworthy contributions to our geographical knowledge.

In the year 1852, Mr. Kelley, of New York, influenced by the early reports of

Humboldt, (who, however, it must be remembered, does not here speak from his own knowledge, but merely recites what is communicated by others,) and inspired by the grandeur of the object, commenced a series of surveys, beginning at the mouth of the Atrato river, and crossing the Cordilleras at several points. Of these surveys I will here give a brief account, in order to show precisely where we stand in regard to this region. What is here said concerning the early history of these undertakings is taken, in part, from a paper communicated to the Royal Geographical Society of London, by its secretary, Dr. Norton Shaw, in 1856.

The first expedition undertaken at the expense of Mr. Kelley and other gentlemen, was placed under the direction of Mr. J. C. Trautwine, an engineer of Philadelphia who had already acquired distinction in Honduras and in the work of the Panama railway. Mr. Trautwine surveyed the mouth of the Atrato, and then ascended the river to Quibdó, examining several of its tributaries in passing. Above Quibdó he followed first the tributary Quito, and then the tributary Pato to its source; here he crossed the dividing ridge of the Cordilleras, and took a canoe on the river Baudo, which he traced to its mouth on the Pacific. Returning on his steps he turned off from the Baudo, at the mouth of the Pepé, which river he ascended to its source, and crossed the mountains on a second track to the river Surucco, one of the headwaters of the San Juan, and proceeded along the last-named river on a third track. He crossed from San Juan to Quibdó, which track leads across the water-shed said to have been intersected by the famous Raspadura canal. The existence of this canal is now disproved, if the word canal is intended to signify a practicable artificial water-course, constructed and employed for the passage of boats or vessels.*

This route was again traversed by Mr. Trautwine when he returned from Quibdó, and navigated the river San Juan throughout its length to the bay of Chirambira, on the Pacific coast. Thus it will be seen that Mr. Trautwine during his expedition crossed the Cordillera at three different places. A copy of Mr. Trautwine's map is included in the appended series and numbered X; it embraces his plan and elevation of the dividing ridge between the Atrato and San Juan rivers.

In 1853, another expedition was fitted out by Mr. Kelley, at his own expense, and placed in charge of Mr. Lane and Mr. Porter, civil engineers of New York, with instructions to extend and follow up the investigations of Mr. Trautwine. Mr. Porter pursued the route previously taken by Mr. Trautwine, ascending the Atrato, and crossing over the dividing ridge to San Pablo, on the San Juan. His observations harmonized entirely with those of his predecessor. Mr. Lane, after examining the Atrato to Quibdó, took the eastern course along the Atrato to the Andagueta, whence he crossed the dividing ridge to the San Juan. He also examined the supposed Raspadura canal. Throughout his expeditions his results agree with those previously reported by Mr. Trautwine.

We may sum up the results of these surveys, so far as the question of an interoceanic canal is concerned, in the following declaration: The examination of the headwaters of the Atrato, of the intervening water-shed, and of the headwaters of the San Juan, satisfactorily proved that nature forbids us altogether to entertain the idea of a union of the two oceans in this direction.

Mr. Kelley's indefatigable spirit of inquiry took a new course. Humboldt had been told that from the bay of Cupica eastward, for a distance of fifteen or eighteen miles, the ground was level and suitable for a canal which would

* It is worth mentioning, as a matter of curiosity, that this canal of Raspadura has been actually laid down on a large chart of South America, and also on a chart of Columbia, both by Brué, and also on a chart of New Granada, given by Malte Brun, (père,) in the 16th vol. of the *Annales des Voyages* for the year 1811. This last chart passed under Humboldt's review. (Malte Brun, (fils,) 1857, p. 22, note.)

terminate on the river Napipi. It was represented to him that between this part of the coast and the valley of the Atrato the chain of the Andes is entirely broken, and on this point he quotes the authority of an intelligent Biscayan pilot. A number of other authorities are cited by Fitz Roy, particularly Lieutenant Wood, royal navy, and Captain Illingsworth, (*Journal Royal Geographical Society*, 1851, p. 178,) who give color to the correctness of this statement by circumstantial facts; and, in addition to all this, the opinion is so current in the country that the native Indians are in the habit of passing, freely and without difficulty, between the Pacific coast and the tributaries of the Atrato, that it probably has some better foundation than we are aware of.

Acting upon these reports, Mr. Kelley fitted out two other expeditions in the year 1854, one of which, under Mr. Lane, was despatched to the Truando, and the other, under Mr. William Kennish, was directed to commence operations on the side of the Pacific. Mr. Kelley's instructions to Mr. Kennish were drawn up in accordance with the preceding information. He was to follow the coast from Point Garachine southward to 7° north latitude, (Cupica bay is $6^{\circ} 41' 19''$ north,) and to look for any depression in the range of the Cordillera which held out the prospect of an open cut without resorting to locks, and on observing any such place, he was to institute a thorough survey, for which the means and instruments were provided.

Mr. Kennish, after passing the bold and mountainous region to the northward of Punta Ardita, met with a remarkable depression opposite that portion of the coast which lies to the southward of that point, and between it and Punta Marzo. Mr. Kennish says in his report: "In this interval the country loses its mountainous character entirely, and assumes the appearance of a gradual rise or slope, with hills of little elevation in the distance."

Opposite this depression of the Cordilleras, he discovered an inlet not before described, but now known as Kelley's inlet, affording convenient shelter and anchorage, into which the Paracuchichi empties its waters.

Encouraged by these favorable conditions, and by the best information he could obtain from the natives, he determined to cross from that point to the Atrato by the shortest course. The party, following the course of the streams on the west of the water-shed, crossed the summit at a height of five hundred and forty (540) feet, and descended over a series of falls to the Nerqua, a tributary of the Truando, along which rivers they proceeded to the Atrato. The information furnished by Mr. Kennish's survey, particularly tending as it did to strengthen the previous reports of Humboldt and other travellers, was received everywhere with attention.

In England, the subject was taken up by the Royal Geographical Society and by the Institution for Civil Engineers, and freely discussed in all its bearings. In the United States the government thought it worth while to ask for a special appropriation to defray the expenses of an expedition to the same region for the purpose of verifying Mr. Kennish's explorations.

This expedition was placed under the direction of Lieutenant (now Brigadier General) Michler, of the engineers, and Lieutenant (the late lamented Commander) T. A. Craven, United States navy; the hydrographic work being assigned to the latter, and "the explorations and verifications of surveys already made near the Isthmus of Darien to the former." The reports of Mr. Kennish were confirmed in all essential particulars; but beyond this—and what, perhaps, is more important—General Michler's work was conducted with all the advantages which the best instruments and the most thorough education can confer. His topography and his levels furnish us with a complete representation of this region, reliable in all its details, and not subject to any of those painful doubts which belong to mere reconnaissance or primary exploration. It is in the highest degree satisfactory to know precisely what we are to expect in this part of the Cordilleras, which has given rise to such ardent hopes in the minds

of numerous writers and explorers, from Humboldt and his native correspondents, who first drew his attention in this direction, down to Kelley and Michler. General Michler, it is very interesting to know, is struck with the same promising but deceptive appearance of the mountain range when viewed from the ocean. He says: "In looking back from the ocean upon the country through which the party recently travelled, the depression in the Cordilleras becomes plainly visible. It seems, in reality, to lose the mountainous character entirely, and assumes the character of a gradual rise or slope, with hills of little elevation in the distance. The dense growth of timber which mantles the crests of the hills makes the resemblance to a low flat region still more apparent; and when beheld from a little distance out at sea the view must be still more strikingly so. One can easily, therefore, conceive why a preference should have been shown to this section by those interested in explorations of a route for a ship canal." (Report, p. 93, Ex. Doc. No. 9, 36th Cong. 2d sess., Senate.)

The annexed sheets, numbered XI and XII, contain the map and profiles of General Michler's line of survey, from the mouth of the Truando to Kelley's inlet. This map, studied in connexion with his itinerary, (pp. 49-99, *ibid.*.) will make the reader thoroughly acquainted with this now celebrated Isthmus of Choco, not only with the physical geography, geology, natural history, &c., but with the mode of travel and the manners and customs of the people.

Both Trautwine and Michler have, through their experience, given us some important lessons upon the conduct of expeditionary parties in these regions. Both of these gentlemen were, in spite of their best precautions, exposed to considerable hardship and privation. (See their reports, *passim*.) I should fail to profit by these lessons if I were not to point out the necessity for providing all future surveying and exploring expeditions with provisions in a concentrated form. This is a matter not to be overlooked.

Before concluding this branch of the subject, I must not omit to mention an important point in which Trautwine and Michler fully concur, and that is, the docile and tractable character of the native Indians. Neither of them had any difficulty in securing aid, and never failed to receive from them kindness and good will. "I never," says Trautwine, "in all my New Granadian experience, felt myself to be among ruffians. Among the Indian tribes through which I passed, I laid aside my pistols and armed myself with a pocketful of cigars. A present of an empty sardine box was more effective than a two-edged sword; and a lump of sugar to a papoose was a better passport than my government could afford."

The greatest regret was experienced by General Michler in being compelled to part with two of his native assistants who had been long with him. These statements must be understood, however, to apply to the Indians of the valley of the Atrato, and not to those of the Isthmus of Darien proper.

CONCLUSION.

We get the idea of the value attached to the construction of a ship canal across the American isthmus—"the mightiest event, probably, in favor of the peaceful intercourse of nations which the physical circumstances of the globe present to the enterprise of man"—from the character of the minds which have taken an interest in the scheme, as well as from the number of projects which have been offered for its fulfilment. Among the governing minds of the world which have recognized the consequences to the welfare of mankind with which this undertaking is pregnant, may be mentioned that of Pitt. It will be remembered by the readers of diplomatic history that the plan for the emancipation of the Spanish colonies from the mother country, which was drawn up by Miranda and his associate deputies and commissioners and presented to the British government, contains in the sixth article a stipulation for the opening of navigation.

between the Atlantic and Pacific oceans by the Isthmus of Panama, as well as by Lake Nicaragua. This document is dated Paris, December 22, 1797. Mr. Pitt entered with promptness into the scheme.

So, also, our own Jefferson bestowed his thoughts and interest upon this subject, as may be seen in more than one of his letters to Mr. Carmichael.

In one of them, dated Paris, May 27, 1788, he says : * * * "With respect to the Isthmus of Panama, I am assured by Burgoine that a survey was made, and a canal appeared very practicable ; but the idea was suppressed for reasons altogether political. He has seen and minutely examined the report. This report is to me a vast desideratum, for reasons political and philosophical." * * * (Jefferson's Works, vol. 2.)

I have spoken of the number of projects which have been offered to the world. Including canals and roads they amount in all to twenty-six, (26,) as shown by the following tables, taken principally from Malte Brun, (fils.)

TABLES.

CANALS.

I.....	1. Tehuantepec, by the Coatzacoalcos and Chicapa.	
II.....	2. Honduras.	
III. { River San Juan de Nicaragua. Lake Nicaragua.	3. R. San Carlos, G. de Nicoya.	
	4. R. Niño, Tempisque, G. de Nicoya.	
	5. R. Sapoa, B. Salinas.	
	6. San Juan del Sur.	
	7. Brito.	
	L. Managua. {	8. R. Tamarinda.
	R. Chagres. {	9. P. Realejo.
IV... Panama {	10. B. Fonseca.	
	11. Gorgona, Panama.	
	12. Trinidad, Caymito.	
	13. Navy Bay, R. Chagres, R. Bonito, R. Bernardo.	
	14. San Blas, R. Chepo.	
V.... Darien {	15. B. Caledonia, G. San Miguel.	
	16. Rs. Arguía, Paya, Tuyra, G. San Miguel.	
	Rio Atrato. {	17. R. Napipi, Cupica.
		18. R. Truando, Kelley's I.
		19. R. Tuyra, G. Urabá or R. Atrato.

ROADS

- I.—Coatzacoalcos, Tehuantepec.
- II.—B. Honduras to G. of Fonseca.
- III.—R. San Juan, Nicaragua, Managua, G. of Fonseca.
- IV.—Chiriqui inlet to Golfo Dulce.
- V.—Aspinwall, Panama, (railroad finished.)
- VI.—Gorgon B., Realejo.
- VII.—Gorgon B., San Juan del Sur.

I have adopted Malte Brun's general classification as being in fact the natural one. It begins with Tehuantepec and ends with Darien and the Atrato. I have, in the preceding pages, considered each one of these general lines separately, and presented an accurate profile; and, in some cases, both map and profile of each on a scale sufficiently large to be perfectly intelligible. Ample data are furnished for estimating distances, heights, summit levels, and locks, where locks form part of the plan; and, in general, for answering all the inquiries of the resolution. I have reported upon "their relative merits as practicable,

lines for the construction of a ship canal," and it now remains for me to express an opinion whether "the Isthmus of Darien has been satisfactorily explored."

The Isthmus of Darien has not been satisfactorily explored. With the exception of the line of survey from Chepo to San Blas, the knowledge of which, through the kindness of Mr. Kelley, is first given to the world in this report, and with the exception of the explorations of Prevost and Gisborne, and the solitary and unrecorded, and therefore unsatisfactory journeys of Dr. Cullen,* the interior of the Isthmus of Darien, east of the Panama railroad, is almost a *terra incognita*.

Strange as it may seem, when it is considered that this is the part of the continent first settled, and that it has always commanded the greatest attention on account of this very question now before us, yet it is strictly true, with the exceptions above, that the best knowledge we possess of the isthmus is derived from the journals of Dampier and his companions, from the reports of Paterson, and from the brief journal, already quoted, of Milla.

There does not exist, in the libraries of the world, the means of determining, even approximately, the most practicable route for a ship canal across the isthmus. Our really authentic information amounts to this, that at that part of the American isthmus where the oceans approach each other, nature has supplied harbors of unsurpassed excellence on both sides, and navigable rivers that invite the traveller to penetrate into the wilderness; while on one side she has established a tidal condition in the highest degree favorable to the needs of a commerce which traverses the great seas. In the immediate neighborhood of this isthmus is a country (of which it forms a part) possessing features that give it eminence among the nations. It has good ports on the Atlantic and Pacific oceans; it is mistress of the Isthmuses of Panama and Darien, which already enjoy great importance in the world's commerce, and are destined hereafter to acquire still more; it has great agricultural resources; while in its physico-geographical structure it embraces valleys traversed by noble rivers; table-lands, at different elevations, that afford a variety of climate and production; and mountains in which still lies buried an incalculable amount of mineral wealth, and at the foot of which the native Indian, with the rudest means and appliances, collects, in a few hours, gold enough to enable him to pass weeks or months in indolence and diversion.

It is to the Isthmus of Darien that we are first to look for the solution of the great problem of an interoceanic canal. We know enough of the interior topography to adopt the view of Dr. Cullen, that if we leave the Indian trail, which always passes over the highest ground, and explore the country beyond the ordinary line of travel, we shall probably find a valley transversely dividing the Cordilleras, or at least a lower ridge than any yet surveyed. Our most trustworthy engineers in these regions, Trautwine, Michler, Prévost, McDougal, and others, tell us that it is impossible, from the very limited inspection of the country taken on the Indian line of travel, to form any conception of the nature of the ground even in the immediate vicinity. This is owing to the unbroken forest of heavy timber, of which Paterson gives an idea in the first letter to the Directors, in the following words: "The hills are clothed with tall trees without any underwood, so that one may gallop conveniently among them many miles, free from sun and rain, unless of a great continuance."—(Dalrymple, *ubi supra*.) But there is also abundant evidence in the accounts of our most recent explorers that there is to be found, in many places, a dense and tangled underwood, which admits of no progress except by removal. The future surveyors must, therefore, go prepared to encounter this as well as other difficulties. There are two provisions which appear to me indispensable in future expeditions:

* Not only unsatisfactory, but it is my duty to say, even doubtful.

First, rations, in a concentrated and portable form, to enable the surveyors to prosecute their investigations at leisure.

Secondly, the means of removing the undergrowth and clearing the way for pioneers ; and for this latter purpose a corps of native Indians may be employed with their *machetes*, and fire may be resorted to, as suggested by Fitz Roy.

I have added to this report some statistical tables, (Appendix No. 1,) derived almost entirely from Mr. Kelley's publications, showing the advantages of this canal, so far as those advantages can be displayed by statistics merely. Statistics, however, constitute the frame-work which, to be correctly understood, must be filled up with all that creates symmetry, progress, and life. Besides, these figures are necessarily limited to the existing state of traffic and intercourse, or, rather, to that which did exist before the commerce of the country was disturbed by the rebellion.

If the distance between the nearest continent and the most ancient seat of human life were diminished by one-half, and if, in addition to this, the voyages between the two hemispheres were rendered much less hazardous and difficult, such an interchange of their production and labor would take place as it is now impossible to imagine. Already the remote colonies of Australia and New Zealand are eager to profit by the advantages of this newer and shorter line of communication. In 1863, the postmaster general of New Zealand arrived in England empowered to offer £30,000 per annum, from the 1st of January, 1864, for four years, as a contribution toward carrying out a steam line *via* the Central American isthmus. New South Wales agreed to vote £50,000 sterling per annum for the same service.* (Pim., p. 374, note.)

It is from a like point of view that we are led into the contemplation of the grandeur of the project for uniting the two oceans. But as a consequence of its importance and general interest to the commerce of the whole world, it is our duty to collect and collate all authentic information before proceeding to the execution of such an undertaking. We must remember that we are about to construct a work that not only must satisfy the necessities of the moment, but must be suited to meet the wants of the future, and be useful to all coming ages.

The interoceanic canal, in width, depth, in supply of water, in good anchorage and secure harbors at both ends, and in absolute freedom from obstruction by lifting locks or otherwise, must possess, as nearly as possible, the character of a strait. It may be thought premature to say that the time has arrived for its execution. But it will not be denied that the present opportunity is the most favorable that could possibly arise for conducting, on our part, the preliminary surveys without interruption, interference, or unwelcome participation.

A list of the principal authorities relating to projects of interoceanic communication through the American isthmuses is appended hereto for the convenience of those who may have occasion to look into this subject either more fully or more comprehensively than is consistent with the prescribed limits and objects of this report.

C. H. DAVIS,

Rear-Admiral, Superintendent.

UNITED STATES NAVAL OBSERVATORY,
Washington, D. C., July 10, 1866.

* While this report is passing through the press we see that a new line of mail packets, subsidized by the government of New Zealand, has been established between Panama and Wellington, making monthly departures from Panama about the 24th of each month, or on the arrival of the mail from Southampton.

APPENDIX NO. I.

Containing several tables compiled by Mr. F. W. Kelley, and designed to present a general view of some of the immediate results of a canal through the isthmus.

Table of the saving in distance from New York to the following places, by the Isthmus of Panama, over the Cape routes :

From New York to—	Distance <i>via</i> Cape of Good Hope.	Distance <i>via</i> Cape Horn.	Distance <i>via</i> the Isthmus of Panama.	Saving in distance over the route by Cape of Good Hope.	Saving in distance over the route by Cape Horn.
	Miles.	Miles.	Miles.	Miles.	Miles.
Calcutta.....	17,500	23,000	13,400	4,100	9,600
Canton.....	19,500	21,500	10,600	8,900	10,900
Shanghai.....	20,000	22,000	10,400	9,600	11,600
Valparaiso.....	.....	12,900	4,800	.....	8,100
Callao.....	.....	13,500	3,500	.....	10,000
Guayaquil.....	.....	14,300	2,800	.....	11,500
Panama.....	.....	16,000	2,000	.....	14,000
San Blas.....	.....	17,800	3,800	.....	14,000
Mazatlan.....	.....	18,000	4,000	.....	14,000
San Diego.....	.....	18,500	4,500	.....	14,000
San Francisco.....	.....	19,000	5,000	.....	14,000
Wellington, N. Z.....	13,740	11,100	8,480	5,260	2,620
Melbourne, Australia.....	13,230	12,720	9,890	3,340	2,830

*Table showing the trade of the United States that would pass through the isthmus canal, if now finished; taken from the official returns for the year 1857.**

Countries traded with.	Exports and imports.	Tonnage.
Russian North American possessions.....	\$126,537	\$5,735
Dutch East Indies.....	904,550	16,589
British Australia and New Zealand.....	4,728,083	52,105
British East Indies.....	11,744,151	177,121
French East Indies.....	98,432	3,665
Half of Mexico.....	9,601,063	34,673
Half of New Granada.....	5,375,354	131,708
Central America.....	425,081	36,599
Chile.....	6,645,634	63,749
Peru.....	716,679	193,131
Ecuador.....	48,979	1,979
Sandwich islands.....	1,151,849	33,876
China.....	12,752,062	123,578
Other ports in Asia and Pacific.....	80,143	4,549
Whale fisheries.....	10,796,090	116,730
California to east United States †.....	35,000,000	861,698
Value of cargoes.....	100,294,687	1,857,485
Value of ships.....	92,874,250	at \$50 per ton.
Total value of ships and cargoes.....	193,168,937	92,874,250

* Congressional Reports on Commerce and Navigation.

† Exclusive of gold dust.

Whale ships and coasting vessels have been estimated generally throughout this Appendix at forty dollars (\$40) per ton. The United States and European commerce around the capes is conducted in first-class ships, which often cost eighty dollars (\$80) per ton; fifty dollars (\$50) have therefore been taken as the fair average value in the construction of this table, which does not include coasting trade.

Table showing the trade of England that would pass through the isthmus canal, if now finished; taken from the official returns for the year 1856.

Countries traded with.	Exports and imports.	Tonnage.
Half of Mexico.....	\$2,775,137	\$11,833
Half of Central America.....	1,244,817	5,615
Half of New Granada.....	2,437,605	10,188
Chile.....	15,486,110	118,311
Peru.....	20,473,520	244,319
Equador.....	360,015	1,820
China.....	7,077,390	68,530
Java.....	3,821,410	16,003
Singapore.....	4,364,070	16,500
Australia and New Zealand.....	78,246,095	522,426
Sandwich islands.....	520,560	1,950
California.....	2,378,105	11,800
Value of trade.....	139,184,834	1,029,295
Value of ships.....	51,464,750	at \$50 per ton.
Total value of trade and ships.....	190,649,584	51,464,750

Table showing the trade of France that would pass through the isthmus canal, if now finished; taken from the official returns for the year 1857.

Countries traded with.	Exports and imports.	Tonnage.
Chile.....	\$10,000,000	\$25,688
Peru.....	13,160,000	35,096
Half of Mexico.....	2,790,000	10,004
Half of New Granada.....	1,090,000	2,389
Equador.....	440,000	1,651
Bolivia.....	100,000	1,000
California.....	2,073,859	8,997
China.....	2,180,000	2,028
Dutch East Indies.....	4,440,000	20,400
Sandwich islands.....	2,000,000	4,119
Philippine islands.....	1,000,000	1,463
Australia.....	19,800,000	50,000
Value of cargoes.....	59,073,859	162,735
Value of ships.....	8,136,750	at \$50 per ton.
Total value.....	67,210,609	8,136,750

Table showing the total tonnage that would pass yearly through the isthmus canal, if now finished; from official returns.

	Tons.
United States.....	1, 857, 485
England.....	1, 029, 295
France.....	162, 735
Other countries.....	44, 555
Total.....	<u>3, 094, 070</u>

Table showing the general results of the foregoing tables.

Tonnage and trade of United States.....	\$193, 168, 937
Do. England.....	190, 649, 584
Do. France.....	67, 210, 609
Do. Other countries.....	16, 802, 000
Total trade affected by the canal.....	<u>467, 831, 130</u>

Table showing the saving in money to the trade of the United States that would result from the use of the isthmus canal; according to the official statistics for the year 1857.

Insurance on vessels and cargoes saved.....	\$3, 863, 378
Interest saved on cargoes.....	3, 008, 840
Saving of wear and tear of ships, five per cent.....	4, 643, 712
Saving of freight money, (by time).....	11, 250, 000
Saving of wages, provisions, crew, &c.....	13, 230, 000
Total yearly saving to the United States.....	<u>35, 995, 930</u>

Table showing the yearly saving in money to the trade of England, as ascertained by the official returns for 1856, if the trade passed through the isthmus canal instead of round the capes.

Insurance on vessels and cargoes.....	\$1, 906, 495
Interest on cargoes.....	1, 858, 826
Saving of wear and tear of ships.....	2, 573, 237
Saving of wages, provisions, &c.....	3, 611, 790
Total yearly saving to England.....	<u>9, 950, 348</u>

Table showing the saving in money to the trade of France that would result from the use of the isthmus canal; according to the official statistics for the year 1857.

Insurance on vessels and cargoes.....	\$753, 000
Interest saved on cargoes.....	452, 084
Saving of wear and tear of ships.....	325, 470
Saving of freight money, estimated by time.....	276, 949
Saving of wages, provisions, and outfit of ships.....	376, 427
Total yearly saving to France.....	<u>2, 183, 930</u>

Table showing the saving to the trade of the world by using the isthmus canal.

United States.....	\$35,995,930
England.....	9,950,348
France.....	2,183,930
Other countries*.....	1,400,000
Total.....	<u>49,530,208</u>

Exports of Great Britain increased one hundred and seven per cent. in ten years. Exports of France increased one hundred and thirty per cent. in ten years. Exports of the United States increased ninety-three per cent. in ten years. If the trade increases one hundred per cent. in the next ten years, the saving to the world will then be ninety-nine millions sixty thousand four hundred and sixteen dollars (\$99,060,416) per annum.

APPENDIX NO. II.

List of maps and profiles prepared for the report on interoceanic communication, in answer to the resolution of the Senate of the United States of March 19, 1866.

No. I. General map of the American isthmuses, showing the various lines proposed for interoceanic communication; compiled by Rear-Admiral C. H. Davis, United States navy, superintendent United States Naval Observatory; July, 1866.

No. II. Profiles of the Isthmus of Tehuantepec, taken from surveys made under the direction of J. G. Barnard, colonel United States engineers, 1851; J. W. Williams, principal assistant.

No. III. Map and vertical section of the proposed Honduras interoceanic railway, located 1857-'58; Squier, Trautwine, Jeffers.

No. IV. Map and profile of the route for the construction of a ship canal from the Atlantic to the Pacific ocean across the isthmus in the State of Nicaragua, Central America; surveyed for American Atlantic and Pacific Ship-canal Company by O. W. Childs, 1850-'51.

No. V. Map of the isthmus between Chagres and Panama; by Chief Engineer Napoleon Garella, 1845.

No. VI. Survey for Panama railroad; Colonel G. W. Hughes, 1849.

No. VII. Map and profile of the route for the construction of a ship canal between the Pacific and Atlantic oceans; A. McDougal, chief engineer; C. A. Sweet, J. E. Forman, and N. Rude, assistants; 1864. (Surveyed for Mr. F. M. Kelley.)

No. VIII. Isthmus of Darien; map showing the routes of Prevost and Gisborne; 1854.

No. IX. Map of part of the Isthmus of Darien by Dr. Cullen; 1853.

No. X. Map of an exploration for an interoceanic canal by way of the rivers Atrato and San Juan in New Granada, South America; laid down from observations made by J. C. Trautwine, civil engineer; 1852.

No. XI. General sketch of the surveys for an interoceanic ship-canal near the Isthmus of Darien, *viá* the rivers Atrato and Truando; Michler, 1858-'59.

No. XII. Interoceanic ship canal, *viá* the Atrato and Truando rivers; Michler, 1858-'59.

No. XIII. Isthmus of Darien from 77° 20' to 80° 10'; compiled at the United States Naval Observatory from various authorities, including maps of 1764; 1865-'66.

* Equated from the trade of England, France, and the United States.

APPENDIX No. III.

List of the principal authorities relating to projects of interoceanic communication through the American isthmuses.

Considerations on the great Isthmus of Central America Captain R. Fitz Roy, Royal Navy, in *Journal of Royal Geographical Society*. Volumes XX, and XXIII. (Library of Congress.)

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Report to the Directors of the Honduras Interoceanic Railway Company. E. G. Squier, esq. London, 1858. *Chemin de fer Interoceanique de Honduras*. Rapport de E. G. Squier. Paris, 1855. (Observatory library.)

The Isthmus of Tehuantepec, being the results of a survey for a railroad to connect the Atlantic and Pacific oceans, made by the Scientific Commission under the direction of Major J. G. Barnard. J. J. Williams, principal assistant engineer. New York, 1852. (Library of Congress: library of State Department.)

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Survey of the Isthmus of Tehuantepec, 1842-'3, under a scientific commission appointed by the projector, Don José Garay, 1842. *Journal Royal Geographical Society*, volume XIV. London, 1844. (Library of Congress.)

Levelings across the Isthmus of Panama, to ascertain the relative height of the Pacific at Panama, and of the Atlantic at the mouth of the river Chagres. John A. Lloyd, in the *Philosophical Transactions of the Royal Society for 1830*. Supplement to the same in *Journal Royal Geographical Society*. Volume I. (Observatory library.)

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Memoria sobre la Geografia, Fisica y Politica, de la Nueva Granada. Dedicada à La Sociedad Geografica y Estadistica de Nueva York. Por el General J. C. De Mosquera, presidente de la Nueva Granada, Miembro Honorario de la Sociedad de Agronomia Practica de Paris, &c., &c., &c. New York, 1852.

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The union of the oceans by ship-canal without locks, *viá* the Atrato valley. F. M. Kelley. 1859.

Explorations through the valley of the Atrato to the Pacific in search of a route for a ship canal. F. M. Kelley, New York, in *Journal Royal Geographical Society*. Volume 26. (Library of Congress.)

Rough notes of an exploration for an interoceanic canal by way of the rivers Atrato and San Juan in New Granada, South America. J. C. Trautwine, civil engineer. Philadelphia, 1854. Also in *Journal Franklin Institute*. Volumes 1854-55. (Smithsonian library.)

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